

**US Army Corps
of Engineers**
Memphis District
Mississippi River Commission

**EASTERN ARKANSAS REGION
COMPREHENSIVE STUDY**

**GRAND PRAIRIE REGION AND BAYOU METO BASIN,
ARKANSAS PROJECT**

**GRAND PRAIRIE AREA
DEMONSTRATION PROJECT**

GENERAL REEVALUATION REPORT

VOLUME 2

**APPENDIX A
NRCS ON-FARM REPORT**

JULY 1998



GRAND PRAIRIE AREA DEMONSTRATION PROJECT

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GRAND PRAIRIE AREA DEMONSTRATION PROJECT

SECTION I

NATURAL RESOURCE PLAN
for the
ON-FARM PORTION

(With APPENDICES A thru C)

NATURAL RESOURCE PLAN
for the
ON-FARM PORTION
of the
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GENERAL RE-EVALUATION - GRAND PRAIRIE AREA
Arkansas, Lonoke, Monroe, and Prairie Counties, Arkansas

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NATURAL RESOURCE PLAN
for the
ON-FARM PORTION
of the
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GENERAL RE-EVALUATION - GRAND PRAIRIE AREA

Abstract

This Natural Resource Plan was developed by the Natural Resources Conservation Service as a part of the Grand Prairie Area Demonstration Project General Reevaluation conducted by the Memphis District Corps of Engineers. The purpose of the reevaluation is to develop an implementation plan to address the declining groundwater supply in eastern Arkansas. Groundwater has historically been utilized as an irrigation source in a large portion of eastern Arkansas. **This plan covers only the on-farm portion of the project** and is an integral part of the project as presented in the General Reevaluation Report. This plan also includes provisions for utilizing the project components to provide waterfowl feeding and resting areas during the fall and winter months.

Recommended solutions to identified problems, opportunities, and environmental impacts are included in this document.

Alternatives considered during plan formulation were a no action alternative, a conservation/storage alternative, an alternate surface source alternative, a combination conservation/storage/alternate surface source alternative, and an alternate groundwater source alternative. The recommended plan is the combination alternative.

This plan was prepared by the Natural Resources Conservation Service (NRCS) formerly the Soil Conservation Service through a cooperative agreement with the Memphis District Corps of Engineers. Other agencies that have contributed to the plan include:

Arkansas Natural Heritage Commission
Arkansas Soil and Water Conservation Commission
Arkansas Game and Fish Commission
U. S. Fish and Wildlife Service

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NATURAL RESOURCE PLAN
for the
ON-FARM PORTION
of the
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GENERAL REEVALUATION - GRAND PRAIRIE AREA

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NATURAL RESOURCE PLAN
for the
ON-FARM PORTION
of the
EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GENERAL RE-EVALUATION - GRAND PRAIRIE AREA

SUMMARY

Project name: EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GENERAL RE-EVALUATION - GRAND PRAIRIE AREA

Counties: Arkansas, Lonoke, Monroe, and Prairie Counties

State: Arkansas

Sponsors: White River Regional Irrigation Water Distribution
District

Description of recommended plan: The recommended plan consists of installation of a water delivery system and on-farm conservation practices throughout the project area. The delivery system will consist of new canals, existing streams, and new pipelines. Water will be pumped from the White River into the delivery system and transported to individual farms. The withdrawal from the river will be limited to that amount determined to be in excess of fish, wildlife, navigation, and other riparian needs.

On-farm conservation practices will consist of storage reservoirs, pipelines, water control structures, and tailwater recovery systems. On-farm storage reservoirs will be constructed on individual farms, will generally be enclosed by levees, and will be filled by pumping. The reservoirs will be filled during late winter and early spring from natural runoff captured through the tailwater recovery systems or from the delivery system when natural runoff is inadequate.

During the cropping season, water will be supplied to the crops from natural runoff captured by tailwater recovery systems, the delivery system, reservoirs, and wells.

Resource information:

Size of project area (acres):	362,662
Land cover-Total Cropland (acres):	254,406
Irrigated Cropland (acres):	247,556
Grassland (acres):	4,571
CRP (acres):	2,279
Forest land (acres):	42,313
Reservoirs (acres):	15,566
Other water	5,707
Miscellaneous (acres):	44,670

Land ownership-Private 98.0 percent State-Local 2.0 percent

Number of farms: 867

Average farm size- (acres):	362
Prime and important farmland (acres):	269,000
Number of minority farmers	37
Number of limited resource farmers	110

Project beneficiary profile: Socioeconomic

	Project Area	State	Nation
Minority Population (%)	20	23	20
Average per Capita Income	\$11,396	\$15,995	\$20,800
Unemployment Rate	6.2%	6.2%	6.8%

Hydric Soils: 67,000 acres (potential wetlands)

Floodplain (acres by land use): N/A

Highly erodible land (acres): 21,300 acres

Endangered Species: None

Cultural Resources:

Humans have inhabited southeast Arkansas including the Grand Prairie area for at least 12,000 years. Prehistoric inhabitants included Native Americans from several cultural periods of which at least one of these cultures included mound building as part of the socio-political structure. Several of these mounds are still present in southeast Arkansas although many have been destroyed by modern farming practices.

Historic exploration and settlement of the area began with the Desoto Expedition and continued to present day. All known cultural resource sites are mapped and will be avoided or preserved in place to the fullest practical extent. Any sites which cannot be avoided or which are discovered during construction will be subject to the requirements of Section 106 of the National Historic Preservation Act of 1966.

Problem identification:

The Mississippi River Valley alluvial aquifer is the primary source of irrigation water for one of the major rice and soybean producing areas in the United States. Groundwater is being withdrawn at such a rate that the aquifer is in danger of being permanently damaged. Irrigation wells are failing. Loss of rice and soybean production in this area would result in severe economic and social repercussions to the local, state, and national economies.

Alternative plans considered:

Alternative No. 1 - No Action Alternative (Without Project)

Install on-farm conservation practices and storage reservoirs utilizing the existing farm programs to improve efficiencies and reduce water needs.

Alternative No. 2 - Conservation/Storage Alternative

Install on-farm conservation practices and storage reservoirs at an accelerated rate utilizing project funds to improve efficiencies and reduce water needs.

Alternative No. 3 - Conservation/Storage/Alternate Surface
Source Alternative

Install on-farm conservation practices to improve efficiencies and reduce water needs in conjunction with a delivery system to provide surface water from the White River.

Project purpose:

Protect the groundwater resource and provide a sustained agricultural water supply while enhancing fish and wildlife habitat.

Project objectives:

Protect the groundwater resource, provide water for irrigation and fish farming, and enhance fish and wildlife habitat.

Project Costs:

Project costs for the on-farm portion are estimated to be \$68,584,000 including \$59,800,000 for conservation measures and \$8,784,000 for technical assistance.

Principal project measures:

Delivery System - A system of new canals, existing streams, and new pipelines will be utilized to convey excess water from the White River to individual properties. The details of the delivery system will be presented in the General Reevaluation Report and technical appendices prepared by the Memphis District Corps of Engineers.

On-farm System - The on-farm systems will consist of storage reservoirs, pipelines, water control structures, pumping plants and tailwater recovery systems. This plan details the on-farm components of the project.

Project benefits:

The primary benefit of the project will be continued irrigated production on 238,707 acres of cropland. Other benefits accruing to the on-farm portion of the project will include energy savings (\$6,576,000), labor savings (\$778,000), and increased yields due to the increased use of surface water (\$2,964,600). Labor benefits will be generated during the construction period.

Other impacts:

A dependable water supply will be provided for 238,707 acres of irrigated cropland and for flooding 45,000 acres of cropland during the fall and winter for waterfowl. Approximately 8,849 acres of cropland will be converted to reservoirs.

Environmental values changed or lost:

Wildlife Habitat (waterfowl)	45,000 acres flooded 30,000 acres managed
Fisheries (surface reservoirs)	+ 8,849 acres
Prime Farmland	- 8,849 acres

Major conclusions:

The environmental assessment of this federally assisted action indicates that this project will not cause significant local, regional, or national adverse impacts on the environment.

Areas of controversy: None

Issues to be resolved: None

INTRODUCTION

The following plan, developed by the Natural Resources Conservation Service, addresses the lack of a dependable water supply for cropland irrigation, fish farming, and wildlife needs in the Grand Prairie area of eastern Arkansas.

As a result of heavy use of groundwater as a source of irrigation water, certain areas of the Mississippi Alluvial aquifer in eastern Arkansas have been mined to extremely low levels. This aquifer is the principal source of irrigation water for most of the farms within the area. Previous studies of the region have indicated that unless alternative sources of irrigation water are located, the groundwater resource may be permanently damaged.

Concerns of local individuals, public officials, and state agencies, prompted a Congressional resolution that directed the United States Army Corps of Engineer Memphis District (MDCOE) to conduct a re-evaluation study of the Grand Prairie area. This plan is being developed to protect the groundwater resource and to provide a sustained agricultural water supply in a demonstration project in the Grand Prairie area of eastern Arkansas. The MDCOE has entered into a cooperative agreement with the United States Department of Agriculture, NRCS in Arkansas to assist in the planning and development of the project.

This document will address only the on-farm portion of the natural resources plan and is part of the overall project plan.

This plan includes a description of the project setting, identification of resource problems and opportunities, scope of the plan, identification and comparisons of alternatives, discussion of public participation, and a description of the recommended plan. Information which supports the conclusions and recommendations can be found in the Appendices.

In addition, a Documentation Report including data sources, assumptions, and methodology used by the NRCS during the study was prepared. The Documentation Report also includes a hard copy example of the data bases utilized in the analysis of the project.

PROJECT SETTING

Location

The Grand Prairie project area encompasses 362,662 acres in east central Arkansas between the Arkansas and White Rivers and covers most of the area known as the "Grand Prairie." This area was once a vast grassland prairie and thus the name "Grand Prairie." During the early 1900's, rice was introduced as a commodity crop and proved to be well suited for production in this area. The Grand Prairie is now one of the major rice producing areas in the world. Arkansas is ranked number one in rice production in the United States and annually produces approximately 40 percent of the national crop.

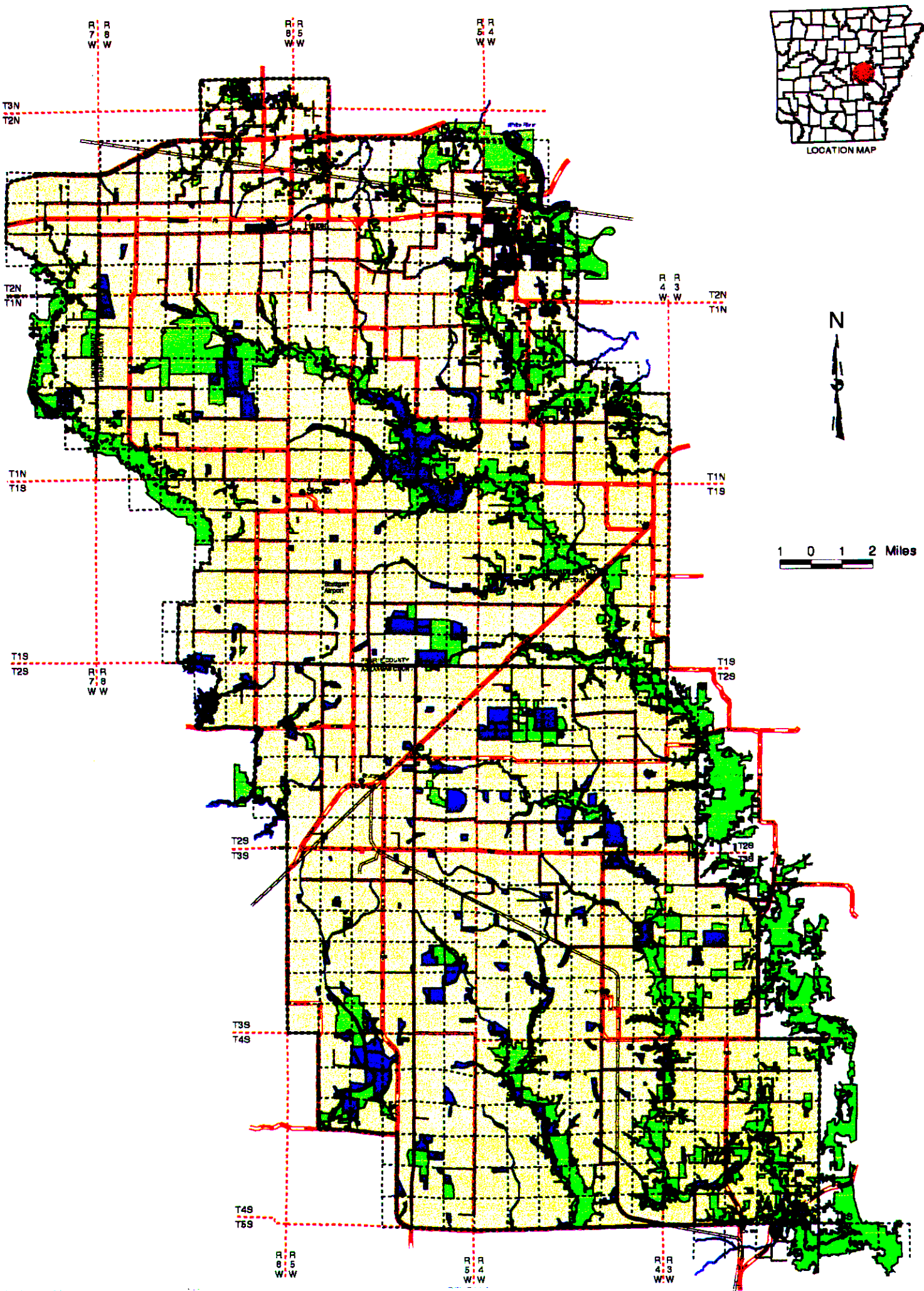
The Grand Prairie project area covers parts of Arkansas, Lonoke, Monroe, and Prairie counties. The project area is approximately 50 miles in length and averages about 15 miles wide with Stuttgart being located near the center.

Stream Systems

Natural drainage of the project area is provided by tributaries of the White and Arkansas rivers. The major tributaries include La Grue Bayou, Little La Grue Bayou, Mill Bayou, and King Bayou. Two Prairie Bayou and Bayou Meto form part of the western boundary of the project area but only a small portion of the project area contributes runoff directly to these streams. There are several smaller tributaries located within the project area which contribute to the drainage of the area.

The largest and most significant of the tributaries is La Grue Bayou. It begins near the northwest corner of the project area and flows southeasterly to the eastern project boundary southeast of the Ulm community. La Grue Bayou continues south and southeasterly near and along the eastern project boundary to its confluence with the White River southeast of DeWitt. Peckerwood Lake is a privately owned impoundment constructed on La Grue Bayou within the project area and is utilized for hunting, fishing, and irrigation.

Little La Grue Bayou is a tributary of La Grue Bayou. It begins northeast of Stuttgart and flows southeasterly to its confluence with La Grue Bayou east of DeWitt. Several small privately owned impoundments and reservoirs have been constructed on and along Little La Grue Bayou. The impoundments generally consist of an earthen levee constructed across the stream with some type of concrete spillway. Many of these spillways are equipped with stop-log type gates utilized to regulate water levels. Impoundments are filled by the natural runoff from the drainage basin.



**PROJECT MAP
EARCS - GRAND PRAIRIE AREA
ARKANSAS, LONOKE, MONROE AND PRAIRIE COUNTIES
ARKANSAS**

BASE MAP LEGEND		
Primary Roads	Project Boundary	Perennial Streams
Railroads	Township	Canals
County	Section	Pipelines
Project Area	Forest Areas	Lakes, Reservoirs

FIGURE 1

Reservoirs are quite different from impoundments in that they are usually constructed adjacent to the stream and are completely enclosed by an earthen levee. They do not block the flow of the stream and are filled by pumping water from the stream during the winter months when stream flows are high. The impoundments and reservoirs are utilized for hunting, fishing, and irrigation.

Mill Bayou begins southeast of Stuttgart and flows southeasterly to the project boundary at U.S. highway 165 and then continues to its intersection with Bayou Meto. From this point, Bayou Meto flows south to the Arkansas River. The impoundments and reservoirs along Mill Bayou are similar to those along Little La Grue Bayou.

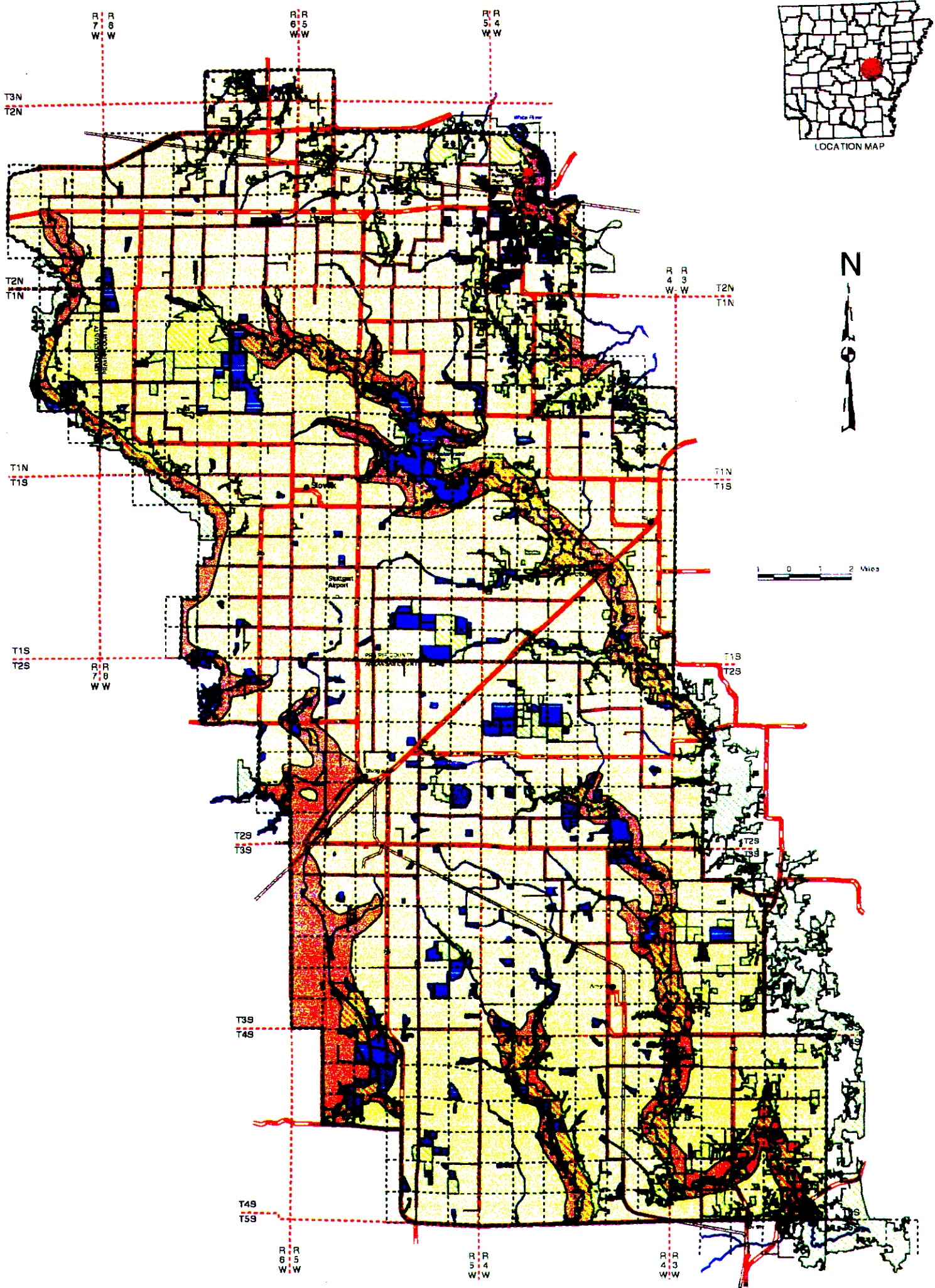
King Bayou begins in southwest Stuttgart and flows generally south to the project boundary near the intersection of Arkansas highways 152 and 343. It then continues generally southwest to the intersection of Bayou Meto which meanders southeasterly until its confluence with the Arkansas River southwest of Gillett. Most of that part of King Bayou located within the project boundaries has been channelized. There are no known impoundments which traverse the bayou. Several totally enclosed reservoirs, similar to those mentioned before, are located along the bayou.

Topography

The Grand Prairie is a nearly treeless and practically level alluvial plain in a northwest to southeast elongated area between Bayou Meto and White River. The plain slopes gently southeastward from an elevation of about 250 feet near Lonoke to about 175 feet near Gillette, giving an average slope of about one foot per mile. Relief is slight, but more prominent along shallow stream valleys. The slight undulation of the plain varies the relief from less than 5 feet per square mile to as much as 10 feet per square mile; however, stream escarpments may be as high as 60 feet near major drainages.

Geology/Hydrogeology

Grand Prairie is a Pleistocene terrace plain which provides a physiographic delineation of the project area. Grand Prairie is a distinct subdivision of the Mississippi Alluvial Plain physiographic region. The project area is underlain by deep sedimentary deposits of the Mississippi Embayment, a geosynclinal trough plunging southward beneath the Mississippi River Valley. The western margin of the embayment is marked by the "Fall Line" about 20 miles northwest of the project. The Fall Line is a common name applied to the abrupt decline of highland rock formations beneath the younger unconsolidated sediments of the alluvial plain; structurally, it represents the western flank of the embayment.



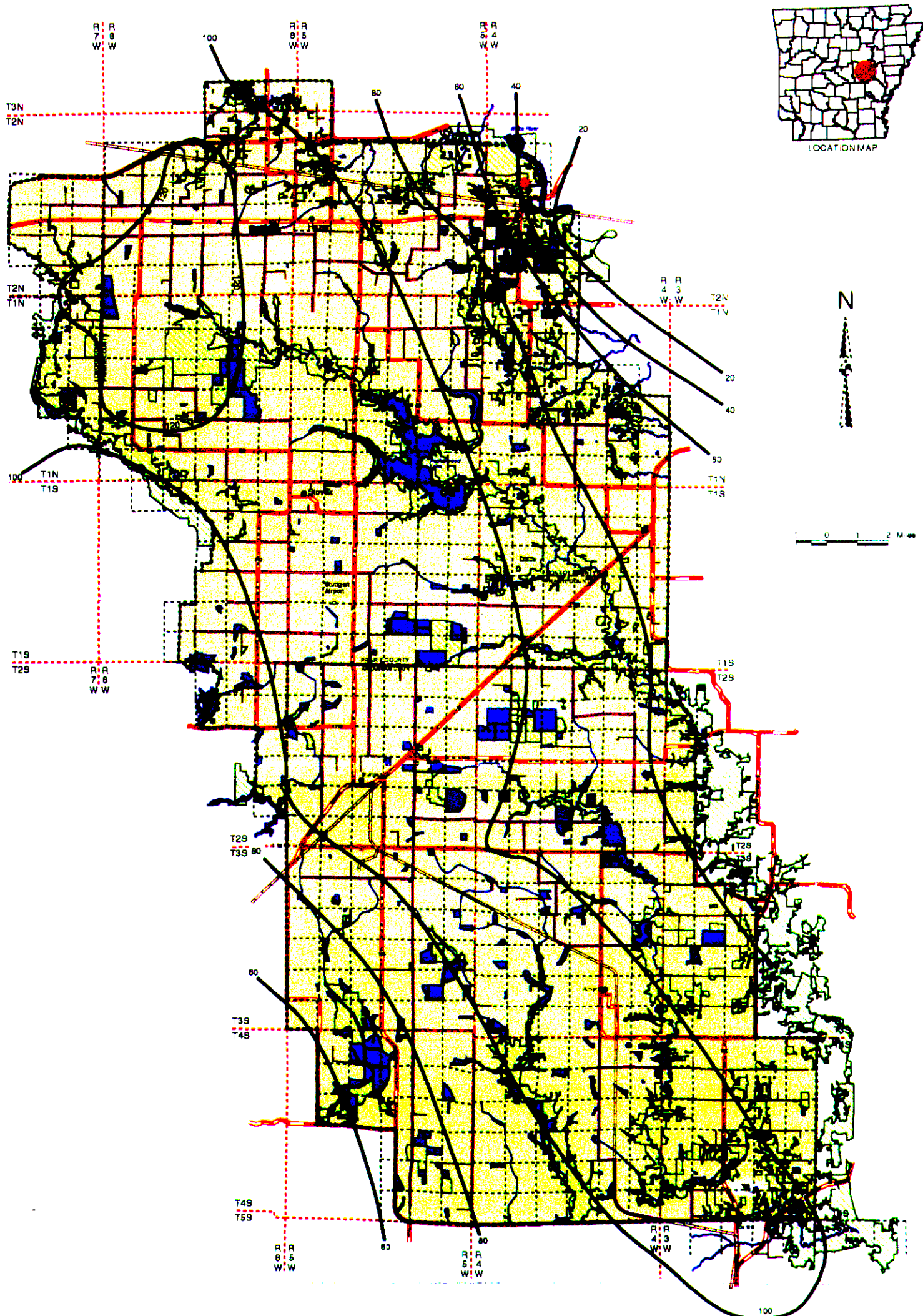
SURFACE GEOLOGY MAP EARCS - GRAND PRAIRIE AREA ARKANSAS, LONOKE, MONROE AND PRAIRIE COUNTIES ARKANSAS

- QUATERNARY PERIOD**
- | | | | |
|--|---|--|---|
| | Alluvial deposits by local streams of the Holocene (Recent) Epoch | | Terraced alluvial deposits of the Pleistocene Epoch |
|--|---|--|---|
- BASE MAP LEGEND**
- | | | | | | |
|--|---------------|--|-------------------|--|-------------------|
| | Primary Roads | | Project Boundary | | Perennial Streams |
| | Railroads | | Township | | Canals |
| | County | | Section | | Pipelines |
| | Forest Areas | | Lakes, Reservoirs | | |

The Mississippi River Valley alluvial aquifer is unconformably underlain by generally less permeable Tertiary strata. Successively downward, the Tertiary deposits consist of interbedded clay, silt, and sand of the Jackson, Claiborne, Wilcox, and Midway Groups. Although some water is withdrawn from sands in the upper three groups, especially the Sparta sand within the Claiborne Group, the overlying Quaternary alluvium remains the principal aquifer for the Grand Prairie region.

Grand Prairie sediments consist of Recent to Pleistocene alluvial deposits ranging in thickness from about 130 to 160 feet. The recent sediments are for the most part concentrated along rivers and streams leaving the Pleistocene deposits largely exposed on terrace surfaces. The Pleistocene strata consist of a basal gravel and coarse to medium sand grading upward to fine sand overlain by clay and silt. The upper low-permeability soils form a confining layer to the underlying sands and gravel which are waterbearing. This confining layer, known locally as the "clay cap", is generally about 60 feet thick over the Grand Prairie, but ranges in thickness from less than 10 feet to more than 100 feet throughout the project area. The water-bearing sediments are continuous over most of eastern Arkansas, and are known as the Mississippi River Valley alluvial aquifer. The aquifer has an estimated average hydraulic conductivity of 270 feet per day or 1900 GPD, ranging from about 120 to 390 feet per day. In the Grand Prairie area, its thickness varies from less than 60 feet to over 140 feet. Most areas range from 80 to 100 feet thick. These thickness variations in the aquifer are related to the paleotopography of the underlying Tertiary contact as well as the variable thickness of the confining layer.

The geology of Grand Prairie was early recognized as conducive to rice production. The alluvial aquifer provided a ready source of irrigation water, and the impermeable confining soils at the surface were recognized as a natural seepage retardant for field inundations. Prior to widespread pumping, regional groundwater flow was probably southward throughout the alluvial aquifer, however, the cone of depression created by over draft in the Grand Prairie has changed the flow direction. The water demand in the Grand Prairie area has lowered the groundwater level by as much as 90 feet. The Grand Prairie cone of depression appears to be extending westward, northwestward, and northeastward.



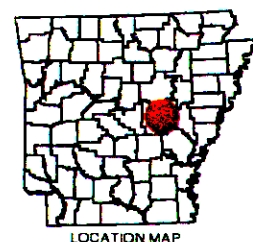
**DEPTH TO WATER MAP OF THE ALLUVIAL AQUIFER
SPRING 1992
EARCS - GRAND PRAIRIE AREA
ARKANSAS, LONOKE, MONROE AND PRAIRIE COUNTIES
ARKANSAS**

WATER DEPTH LEGEND

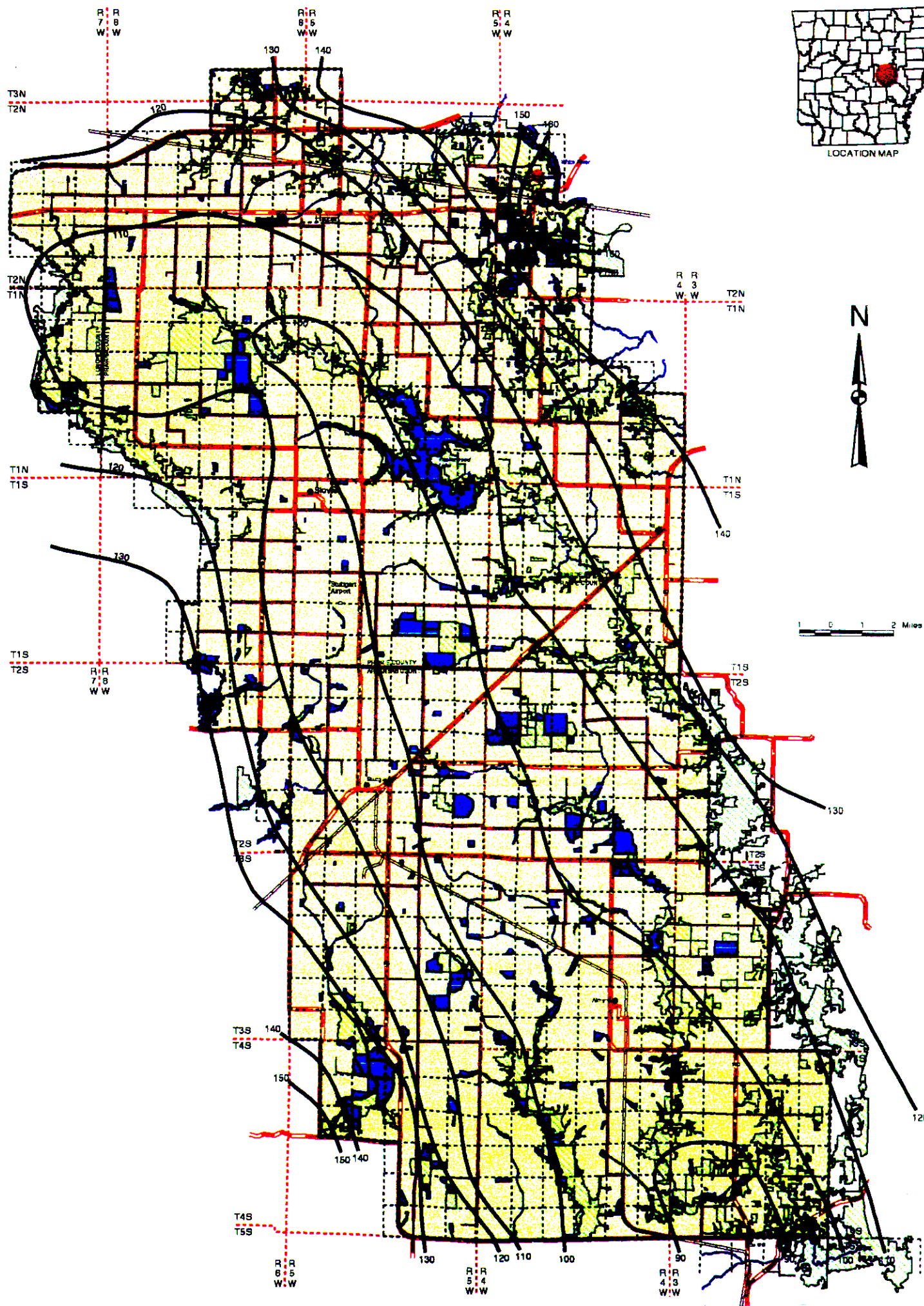
..... 120 Line of equal depth to water, contour interval is 20 Ft.
Datum is land surface. Hachures indicate depression.

BASE MAP LEGEND

- | | | |
|---------------|------------------|-------------------|
| Primary Roads | Project Boundary | Perennial Streams |
| Railroad | Township | Canals |
| County | Section | Pipelines |
| Project Area | Forest Areas | Lakes, Reservoirs |



0 1 2 Miles



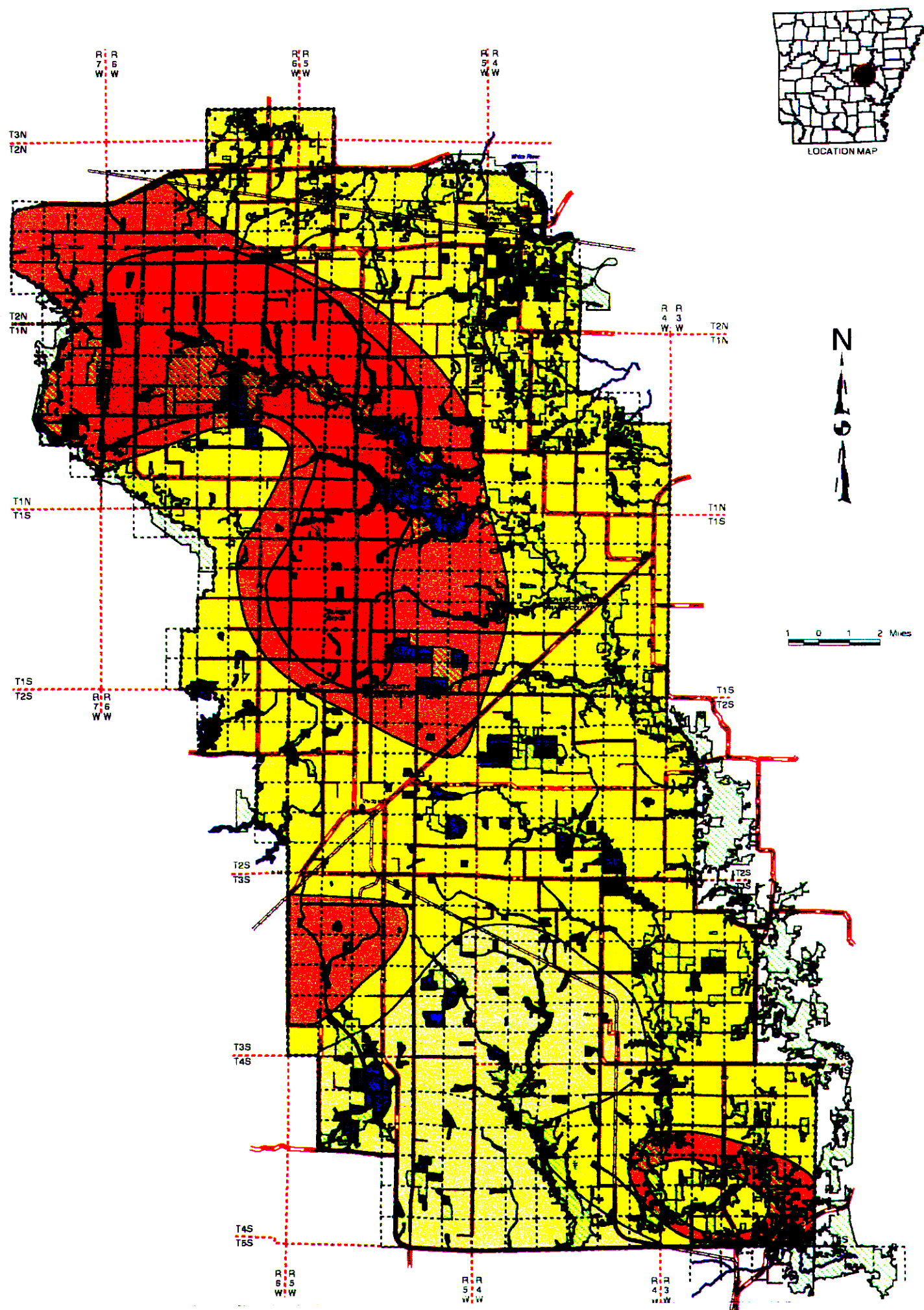
**POTENTIOMETRIC CONTOUR OF THE ALLUVIAL AQUIFER
SPRING 1992
EARCS - GRAND PRAIRIE AREA
ARKANSAS, LONOKE, MONROE AND PRAIRIE COUNTIES
ARKANSAS**

POTENTIOMETRIC LEGEND

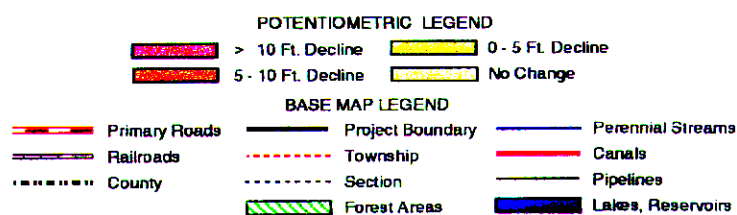
100 Potentiometric contour of the Alluvial Aquifer
Contour interval is 10 feet

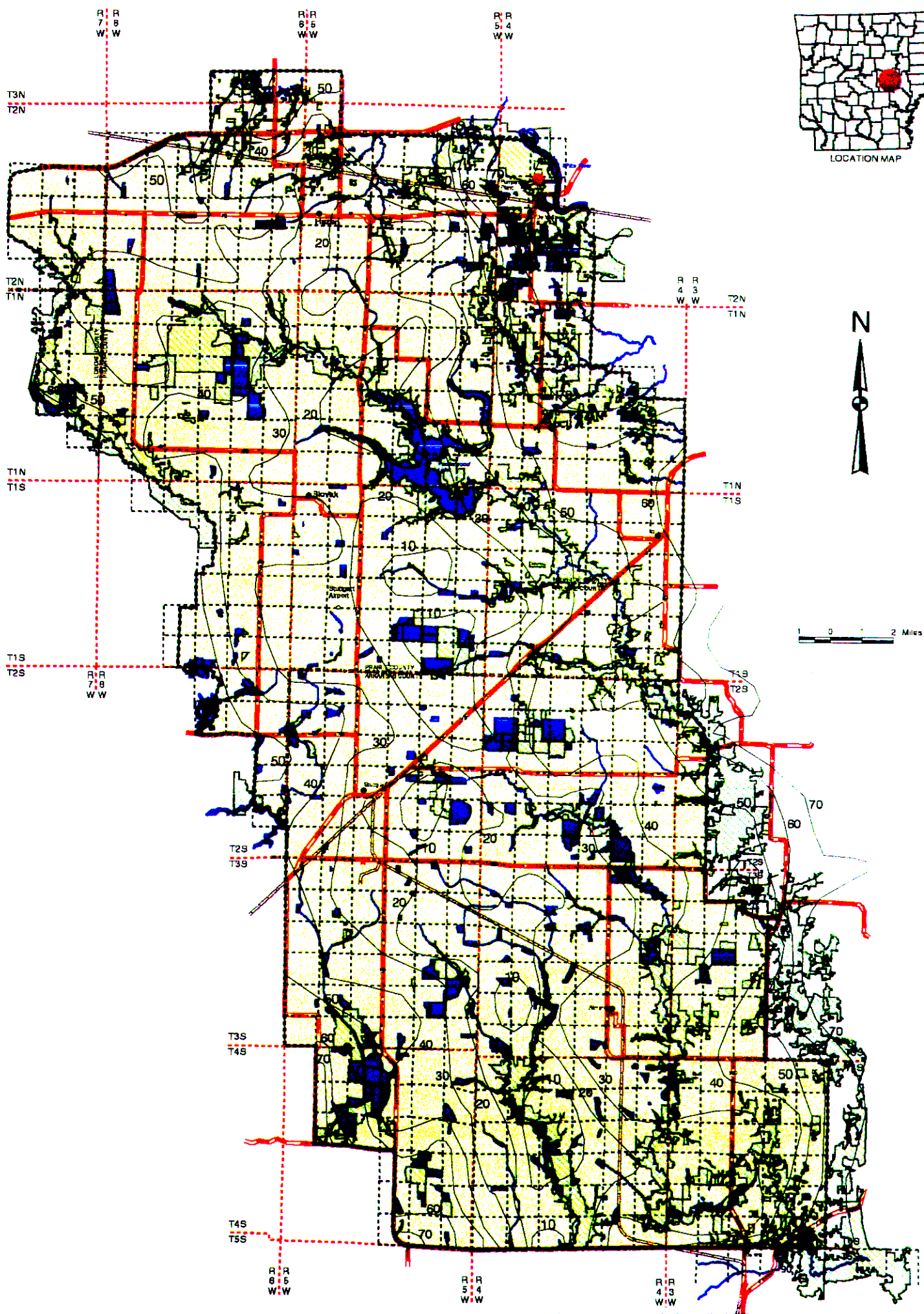
BASE MAP LEGEND

- | | | |
|---------------|------------------|-------------------|
| Primary Roads | Project Boundary | Perennial Streams |
| Railroads | Township | Canals |
| County | Section | Pipelines |
| Project Area | Forest Areas | Lakes, Reservoirs |

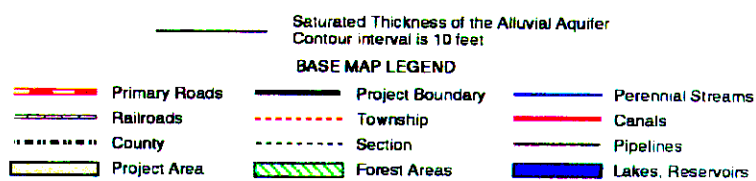


**POTENTIOMETRIC SURFACE CHANGE IN THE ALLUVIAL AQUIFER
SPRING 1987-SPRING 1992
EARCS - GRAND PRAIRIE AREA
ARKANSAS, LONOKE, MONROE AND PRAIRIE COUNTIES
ARKANSAS**





**SATURATED THICKNESS OF THE ALLUVIAL AQUIFER
SPRING 1992
EARCS - GRAND PRAIRIE AREA
ARKANSAS, LONOKE, MONROE AND PRAIRIE COUNTIES
ARKANSAS**



Recharge to the alluvial aquifer is approximately 125,000 acre-feet/year. The majority of the recharge is lateral flow from the White and Arkansas Rivers. The White River is the largest contributor at 37,700 acre-feet/year followed by the Arkansas River at 34,350 acre-feet/year. The conforming clay beds limit vertical percolation, however, they are absent in small areas and tend to be thinner near the perimeter of the Grand Prairie. Vertical percolation accounts for approximately 22,500 acre-feet/year. The fall line on the north side contributes another 18,400 acre-feet/year, and lateral flow from the south to north from the Arkansas/White confluence area equals 10,850 acre-feet/year.

Soils

Soils within the project area primarily consist of silt loams and are ideally suited to the production of agricultural crops. The major soils within the Grand Prairie project area include the Calhoun, Calloway, Crowley, Loring, Stuttgart, and Tichnor series.

Farmland is classified according to its potential for the production of food, feed, fiber, forage, and oilseed crops. The categories include: prime farmland, unique farmland, and farmland of statewide importance.

The Calhoun, Calloway, Crowley and the Loring series, where slope gradient is 3 percent or less, are classified as prime farmland. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops.

The Stuttgart, Tichnor, and Loring series, where slope gradient is 3 to 8 percent, are classified as additional farmland of statewide importance. This land is of statewide importance for the production of food, feed, fiber, forage, and oilseed. It would be classified as prime farmland except for minor physical or chemical limitations such as slope, flooding or natric (salty) horizons. These soils may produce as high a yield as prime farmlands if conditions are favorable and/or if managed properly.

No unique farmland is identified within the project area.

The Calhoun series consists of very deep, level, poorly drained, slowly permeable, loamy soils on broad flats. These soils are well suited for rice production and moderately suited for most other crops. Wetness is the main restriction on these soils and surface drainage is needed in most areas. Most areas of this soil have been cleared and are used for production of rice, soybeans, and grain sorghum.

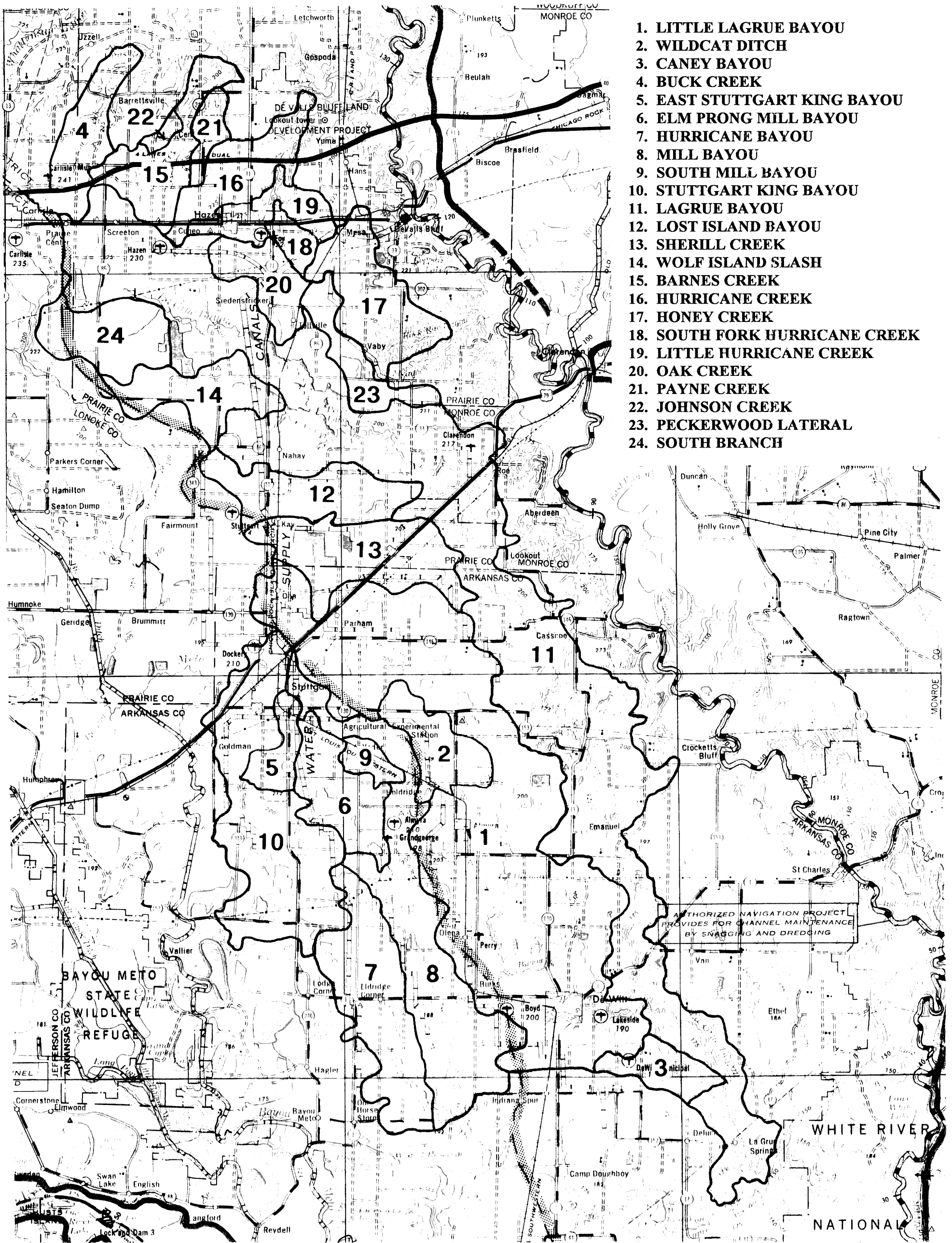
The Calloway series consists of very deep, level to nearly level, somewhat poorly drained, slowly permeable, loamy soils on terraces. These soils typically have a compact, brittle fragipan at a depth of about 24 to 36 inches. These soils are well suited for crop production. Wetness is a moderate limitation on level areas and surface drains may be needed. Erosion is a moderate hazard on nearly level areas. Practices such as minimum tillage, contour farming, and the use of cover crops help reduce runoff and control erosion. Most areas of this soil have been cleared and are used for production of soybeans, rice, grain sorghum, and wheat.

The Crowley series consists of deep, level, somewhat poorly drained, very slowly permeable, loamy soils on terraces. These soils typically have layers with high clay content within about 12 to 30 inches of the surface. Depth to these layers should be determined before land leveling is attempted. This soil is well suited to cultivated crops such as rice, soybeans, and grain sorghum. Wetness is a moderate limitation and surface drainage may be needed in some areas. Nearly all the acreage of this soil is cultivated.

The Loring series consists of very deep, nearly level to moderately steep, moderately well drained, slowly permeable, loamy soils on terraces and uplands. The soils typically have a compact, brittle fragipan at a depth of about 20 to 32 inches. The soils are well suited to poorly suited for crop production depending on slope gradient. Erosion is a moderate to very severe hazard on these soils and erosion control measures are needed in most areas. The main crops grown on less sloping areas include soybeans and winter small grains. The moderately sloping to moderately steep areas are used mainly for pasture and woodland.

The Stuttgart series consists of very deep, level to nearly level, moderately well drained, very slowly permeable, loamy soils on terraces. These soils typically have layers with high clay content within about 18 to 30 inches of the surface. Depth to these layers should be determined before land leveling is attempted. This soil is well suited to cultivated crops such as rice, soybeans, and grain sorghum. Wetness is a moderate limitation on level areas and surface drains may be needed. Erosion is a moderate hazard on nearly level areas. Practices such as minimum tillage, contour farming, and the use of cover crops help reduce runoff and control erosion. Nearly all the acreage of this soil is cultivated.

The Tichnor series consists of very deep, level, poorly drained, slowly permeable, loamy soils on flood plains. These soils are normally flooded each year for long periods, mainly during the winter and spring. Most of the acreage is woodland and used for wildlife habitat. A few areas have been cleared and are used for short growing season varieties of soybeans, but in some years flooding is likely to damage the crop.



1. LITTLE LAGRUE BAYOU
2. WILDCAT DITCH
3. CANEY BAYOU
4. BUCK CREEK
5. EAST STUTTGART KING BAYOU
6. ELM PRONG MILL BAYOU
7. HURRICANE BAYOU
8. MILL BAYOU
9. SOUTH MILL BAYOU
10. STUTTGART KING BAYOU
11. LAGRUE BAYOU
12. LOST ISLAND BAYOU
13. SHERILL CREEK
14. WOLF ISLAND SLASH
15. BARNES CREEK
16. HURRICANE CREEK
17. HONEY CREEK
18. SOUTH FORK HURRICANE CREEK
19. LITTLE HURRICANE CREEK
20. OAK CREEK
21. PAYNE CREEK
22. JOHNSON CREEK
23. PECKERWOOD LATERAL
24. SOUTH BRANCH

EASTERN ARKANSAS WATER SUPPLY STUDY
GRAND PRAIRIE DEMONSTRATION PROJECT

STUDY AREA WATERSHEDS

U. S. ARMY CORPS OF ENGINEERS
MEMPHIS DISTRICT

Minor soils within the project area include moderately well drained, loamy Grenada soils on terraces and uplands; well drained, loamy McKamie soils on uplands; moderately well drained, loamy Muskogee soils on terraces and uplands; and moderately well drained, loamy Oaklimeter soils on floodplains.

Most of the soils in the project area have restrictive layers at 10 to 12 inches which have developed from long term farming. These dense layers, known as traffic pans, limit rooting depth, water holding capacity, and restrict vertical groundwater recharge. As a result, crops cannot endure long periods without rainfall or irrigation.

Climate

The climate is broadly classified as ranging from humid to subhumid. Monthly average temperatures range from approximately 43 degrees F in January to approximately 83 degrees F in July. Summers are normally long and warm with relatively mild and short winters. However, occasional periods of excessive summer heat and winter cold are characteristic of the area. The first and last killing frosts normally occur in mid-October and early April. The mean freeze-free period is about 200 days.

Precipitation is predominantly of the shower type except for occasional periods of general rainfall during the late fall, winter, and early spring. The average annual number of days with measurable precipitation is about 73. Rainfall quantities are the least in the summer and fall when monthly precipitation totals average 3 to 4 inches. The average annual rainfall for the project area is approximately 47 inches based upon the gage station at the University of Arkansas Experiment Station east of Stuttgart.

Rainfall varies from a maximum monthly average of about 5 inches in May to 2.7 inches in October. Table 1 lists the average rainfall by months, in inches.

TABLE 1

Month (In)	Rainfall (In)	Month	Rainfall
January	3.63	July	2.88
February	3.49	August	3.21
March	4.92	September	3.91
April	4.46	October	2.68
May	4.99	November	4.05
June	3.53	December	5.61

Socio-Economic Conditions

The socioeconomic data for Arkansas and Prairie county are reflective of the socioeconomic conditions in the study area which includes the city of Stuttgart and a large part of Carlisle. Other smaller communities in the area are DeWitt, Almyra, Roe, Hazen, Ulm, and DeValls Bluff. The population within the study area was estimated to be 22,080 in 1990. About 20 percent of the population was minority. The median age in the area is 35.4 years. The 1990 population for the state of Arkansas and for the United States were 2,405,000, and 247,000,000 persons respectively. The 1990 study area population was 2250 or 9.8 percent less than the 1980 population. This compares to a national growth rate of 9.3 percent and a 5.2 percent growth for the state.

The employment in the area totaled 10,425 in 1993 with an unemployment rate of about 6.2 percent. Employment for the state and the United States for the same period was 1,091,000 and 119,306,000, respectively. This employment was concentrated in manufacturing and retail trade for the study area, state, and nation. The average unemployment was 6.2 percent for the state of Arkansas and 6.8 percent for the United States as of 1993.

Study area per capita income was estimated to be \$11,396 for 1993. Averages were \$15,995 for the state and \$20,800 for the United States. Average income in the study was lower than both Arkansas and the United States.

There are 867 farms in the study area with an average of about 362 acres per farm. The average value per acre of land and buildings was \$882 in 1992. About 20 percent of the farmers have their principal occupation off the farm.

There are 1362 landowners in the project area, including several parcels of land with joint ownership, comprising 867 farms. There are 304 women and 37 minority farmers in the area. Eight farmers are handicapped. Approximately 110 of the producers in the project area are limited resource farmers.

All of the existing cropland in the Grand Prairie study area is used for irrigated crop production. The soils in the area have similar cropping and irrigation characteristics.

The NRCS provides technical assistance to individuals, groups, and units of government. NRCS assists landowners within conservation districts to develop and apply resource conservation systems to solve erosion, water quality, water conservation, and other resource condition problems on cropland, pastureland, woodland, rangeland, mined land, and other disturbed areas. It also helps landowners and operators conserve, manage, improve, and increase habitat for fish and wildlife.

NRCS provides technical assistance in determining where conservation practices are practical, preparing conservation plans and designs. NRCS also supervises and certifies proper installation of the practices. Financial assistance to install conservation practices is available for farmers, ranchers, and private nonindustrial owners of forest land. The Federal Government typically pays 50 percent of the installation cost of eligible conservation practices up to a limit established in each county by a local committee.

Cost sharing for soil, water, and forestry practices of long-term benefit is provided by USDA's Farm Service Agency (FSA), (formerly the Agricultural Stabilization and Conservation Service).

It is the NRCS policy to perform a Civil Rights Impact Analysis for watershed projects and environmental assessments. The purpose of the analysis is to examine the civil rights implications of NRCS actions related to employment, management, program development, program implementation, or decision making and prevent any adverse impact on employees as well as on program beneficiaries, such as socially and economically disadvantaged groups, minorities, women, and persons with disabilities.

Conservation Level

Average irrigation efficiencies are estimated to be approximately 60 percent, which coincides with estimated efficiencies in the Eastern Arkansas Region Comprehensive Study. This value was determined utilizing data from the Eastern Arkansas Water Conservation Project (EAWCP) and from the Irrigation Water Needs Analysis Worksheet prepared for a typical farm within the project area. During the EAWCP, 20 season long studies were conducted on continuous flood rice irrigation and 25 evaluations were conducted on other crops using intermittent flood irrigation.

Storage Level

A detailed analysis to determine optimum storage levels was performed in the Eastern Arkansas Region Comprehensive Study. This work indicated an optimum storage level of 25% of existing water use should be provided in storage. This value was utilized in the water budget program to compute import water requirements.

Land Use and Cover

Agricultural production accounts for most of the economic activity in the project area and is expected to continue to be the dominant economic activity in the foreseeable future. Cropland comprises the majority of land use, approximately 75 percent, in the project area. The total acreage of the study

area is 362,662 acres. Irrigated cropland amounts to 247,566 acres. Major crops are rice (87,883 acres) and soybeans (146,809 acres) with small acreages of corn (5,598 acres) and grain sorghum (7,238 acres). About 56,909 acres of late soybeans are double cropped with wheat. Grass and CRP amount to 6,850 acres. Forestland is 12 percent of the project area and is made up principally of upland hardwood communities. Water area totals 21,273 acres with 15,566 acres of that in irrigation reservoirs. Total other uses cover an area of 44,670 acres that includes urban, transportation, etc. Other land use consists primarily of ponds, roads, and domestic and agricultural buildings. Primary land use is shown in Table 2.

TABLE 2

Land Use		
Land Use	Acres	Percent
Irrigated Cropland	247,556	68.3
Pasture, Hayland, Prairie	4,571	1.3
CRP	2,279	0.6
Forestland	42,313	11.7
Reservoirs	15,566	4.3
Other water	5,707	1.5
Other ^{1/}	44,670	12.3
Total	362,662	100.0

1/ This category includes transportation services, commercial, industrial, community services and "other" land uses. This value rounded down to correct for rounding errors. Future cropping patterns and land use are expected to shift to dryland cropping as the water available for irrigation decreases under the without project conditions.

Cultural Resources

Human inhabitation in southeast Arkansas has spanned a period of at least 12,000 years. The prehistoric occupation by Native American populations has been subdivided into several culture periods based upon various technological, social, and subsistence adaptations over time. In generalized terms, these are the Paleoindian period (ca. 12,500-9,500 B.P.), Archaic period (9,500-1,500 B.P.), and Post Contact period (1540-present). For

a detailed summary of the entire sequence, the reader is advised to consult the Arkansas State Plan (Davis, Ed. 1982).

The prehistoric culture periods of particular interest in the project area range from the Middle Archaic through Woodland periods inclusive. In the Arkansas River Lowland region, Archaic site components are relatively common but the nature of daily life activities has yet to be clearly understood. The hunting and gathering subsistence strategies that predominate the Archaic period are generally thought to be adaptations to changing Holocene environments (Griffin 1967). Settlement systems appear to be based on organized bands of people coalescing and dispersing during seasonal rounds.

Through time, as the number and population of Late Archaic components increased, a certain degree of economic specialization occurs. Altschul (1981) attributes this to the increased resource exploitation of "ecological seams" as a result of Poverty Point cultural influences toward a more structured and sedentary settlement pattern.

The transition to and developmental characteristics of Early Woodland sites are extremely difficult to postulate because so few sites are known in this vicinity. These sites are thought to represent small hamlet-sized loci of limited activity and are distributed on natural levees of relict meander belts. As settlement and community patterns became increasingly structured, site distribution shows a marked increase.

During the Baytown period (A.D. 300-700), sites become larger and more varied, suggesting a stable, increasing population and the development of more complex socio-political organizations. Mound building was not only for burials but were also used as the base for building structures.

The succeeding period is Coles Creek (A.D. 700-1000). These sites range in size from multiple mound complexes to small midden areas that are interpreted to be a hierarchical organization of villages, hamlets, small farmsteads, or camp sites (Rolingson 1982: SEU 6).

Research at the Toltec site (3LN42) has defined a new Plum Bayou Culture (Rolingson 1982) that spans the later Baytown and Coles Creek periods. Based upon the material culture assemblage, the Plum Bayou culture is distinctive from Coles Creek sites farther to the south in the Felsenthal subregion (c.f. Rolingson and Schambach 1981). The Plum Bayou sphere of influence ranges from the White River lowland to the Bartholomew-Macon subregion and is centered primarily within the Arkansas River lowland.

The succeeding Mississippi cultures in the project area are not well understood due to a lack of known sites. Middle to Late Mississippian phases have been documented to the south and east. Some Late Mississippian and Quapaw affiliated sites are

distributed throughout the vicinity of the Arkansas River lowland.

The historic exploration and settlement of southeast Arkansas area began indirectly with the DeSoto Expedition that was later followed by fur trappers and tradesmen primarily of French origin. During the Pioneer period (ca. 1780-1850), the state's rural population expanded and a strong agricultural base developed. Plantation holdings similar to the structure of antebellum society farther south were established (mostly post 1800) in the alluvial bottomlands of the eastern delta. Limited fractional holdings secured under the homestead acts beginning in 1819 provided immigrants with the subsistence base for creating small local communities. The post Civil War era witnessed a fragmentation of the plantation structure in which large land holdings were reduced in size, and the number of individually owned plots increased. This eventually led to a neoplantation development (Prunty 1955) with small, sharecropper farms tied to a decentralized plantation complex. The Tenant Farm period (ca. 1870-1950) is the most dynamic phase of economic and social growth which was dominated by commercial agriculture. Changing agricultural markets, partially brought about by increased post-WW II farm mechanization, eventually brought about a reduction in the number of support and residential units to what the modern agricultural land use patterns closely resemble today.

This section gives the general cultural history which suggests the potential cultural resources of the project area. If elements of the proposed plan are implemented, the lead federal agency must carry out the requirements of Section 106 of the National Historic Preservation Act of 1966, as amended, prior to implementation. Significant cultural resources identified during implementation will be avoided or otherwise preserved in place to the fullest practical extent.

PROBLEMS AND OPPORTUNITIES

The major resource problem in the project area is the lack of a dependable water supply to continue to irrigate cropland.

Approximately 100 percent of the cropland within the project area is currently irrigated. The groundwater supply is being depleted rapidly. Agricultural production is expected to decline as almost 175,000 acres of currently irrigated land reverts to dryland production. This will reduce expenditures on production goods of almost \$20,000,000 annually.

Opportunities exist for enhancing environmental values in the area and to improve the quality of life for residents in the project area and nearby communities.

SCOPE OF THE NATURAL RESOURCE PLAN

The U.S. Water Resource Council's document, Principles and Guidelines for Water and Related Land Resources Implementation Studies requires a scoping process to identify the range of actions, alternatives, and impacts to be considered. The issues significant in defining the problems and formulating and evaluating alternative solutions are summarized in Table 3. Concerns displayed with a high or moderate degree of significance are discussed in more detail in the document. For a discussion of the scoping process used, refer to the section entitled "CONSULTATION AND PUBLIC PARTICIPATION."

TABLE 3
IDENTIFIED CONCERNS
GRAND PRAIRIE PROJECT

Economics, Social Env., and Cultural Concerns	Degree <u>1/</u> of Concern	Degree <u>2/</u> of Significance	Remarks <u>3/</u>
Flood Protection	Low	Low	Project is expected to have minimal impact on flooding
Cultural Resources	High	Medium	None
Natural Areas	High	Medium	May have minimal impact on Rail Road Prairie
T & E Species	High	Low	None present
Fish Habitat	Medium	Medium	Larger ditches and reservoirs may provide additional fishery
Health & Safety	Low	Low	No impact
Important Ag Land	Medium	Medium	Continued irrigation will maintain production and agricultural inputs
Highly Erodible Cropland	Low		Very few acres of HE land in project area
Water Quality	Low	Low	Minimal impact toward improvement
Groundwater	High	High	Continued withdrawal will deplete aquifer
Air	Low	Low	Temporary dust

1/ Degree of Concern (High, Medium, or Low), in general

2/ Degree of Significance (High, Medium, or Low), potential formulation

3/ Explanation of Significance

TABLE 3 (cont'd)

IDENTIFIED CONCERNS
GRAND PRAIRIE PROJECT

Economics, Social Env., and Cultural Concerns	Degree <u>1/</u> of Concern	Degree <u>2/</u> of Significance	Remarks <u>3/</u>
Transportation/Navigation High	Low		Minimal impacts on navigation.
Recreation	High	High	Additional flooded acreage will be available for private hunting.
Waterfowl	High	High	Additional flooded rice acreage will be available for resting and feeding.
Wetlands	High	Low	Ditches will be installed on existing cropland.
Visual Resources	Low	Low	Ditch banks planted with native prairie species will enhance diversity.
Social and Economics	High	High	Threatened reduced economic activity from shift to dryland farming
Limited Resource Farmers	High	Low	Cost share available
Wildlife Habitat	Medium	Medium	Additional rice flooded for fall resting, feeding, and hunting.
Minorities	High	Low	Stuttgart, Hazen, and other communities have minority populations which depend on the farm economy.

FORMULATION AND COMPARISON OF ALTERNATIVES .

Formulation Process

The process used to formulate alternatives was based on the primary objectives of the sponsors. The objectives are to protect the groundwater resource, to provide an adequate supply of water for irrigation and fish farming, and to enhance fish and wildlife habitat.

The sponsors hope to develop a plan to achieve their primary objectives while minimizing adverse environmental impacts and without inducing flood damages.

The sponsors recognize an opportunity to supply an economical source of water for flooding cropland for wildlife feeding and resting areas during the fall and winter.

Several options were considered in the development of the final alternatives. These options included: No action; Installation of conservation practices and storage reservoirs; Development of alternate surface sources; Combination of conservation/storage/alternate surface source; and Development of alternate underground sources.

Two of the options were determined not to be practical in the early stages of the planning process and were not developed as alternatives. The options eliminated were: development of alternate surface sources and development of alternate underground sources.

Preliminary analysis of the White River and streams in the project area indicated inadequate surface water flows to support peak irrigation requirements without other project features. It was also considered impractical to design a delivery system for peak use capacity when wide ranges of natural flow would occur.

All alternatives were formulated considering the four tests of completeness, effectiveness, efficiency, and acceptability as stated in "Principles and Guidelines" established as rules in accordance with the Water Resources Planning Act of 1965. More emphasis is placed on environmental and social concerns.

One alternative which meets the objectives of the sponsors was formulated. Another alternative displayed for comparison purposes is the No-Project Action Alternative. The No-Project Action does not meet the sponsor's objectives nor does it meet the four tests for a viable project as stated in "Principles and Guidelines."

The White River was chosen as the surface water source because of its proximity to the area and the supply of excess water was usually adequate. "Excess" water is defined in the State Water Resource Plan. Most of the irrigators are currently using wells as their source of groundwater.

The strategy is to use existing streams and canals to convey the imported water wherever possible. Where no streams or canals presently exist an open channel canal or underground pipeline is planned.

A combination of underground pipelines, existing streams and canals, and new canals will be used to convey surface water to individual farms. Pipelines are the preferred method of delivering water when relatively small volumes are required. Open channel construction is recommended for larger flows serving multiple farms where there are no existing streams or canals available. Canal locations were chosen to maximize gravity flow within the delivery system. New canals will generally be constructed along ridges currently in cropland production. This should minimize impacts to low, wetland areas. **Construction of irrigation reservoirs will not be permitted in wetland areas** unless all required permits and clearances are obtained and may require mitigation.

Water management plans will be prepared for each farm to improve the efficiency to 70 percent. These plans will provide recommendations for storage reservoirs, tailwater recovery systems, better application techniques, and additional water conveyance systems. This will help in conveying, measuring, and monitoring inflows and outflows of water from all sources.

The enhancement of wetlands within the project area will be on a voluntary basis. Water may be delivered utilizing the on-farm irrigation system. Incentives for wetland enhancement may be available through water pricing structures or cost-share payments such as the Wetland Reserve Program.

The capacity of the delivery system was designed to provide sufficient irrigation water with on-farm water conservation measures in place. The sponsors will recommend an individual water conservation plan for each irrigator. Technical and financial assistance for the on-farm conservation practices will be provided as part of the project.

In formulating the project plan, consideration was given to dividing the project area into evaluation units based on types of on-farm practices recommended. This effort proved to be futile because all of the project measures are necessary to achieve the objectives of the sponsors. The measures planned are an interdependent system. All of the planned features work together and are needed to meet the project objectives. Therefore, the total project area was

evaluated as one unit. The Recommended Plan described herein maximizes net contributions to the project objective.

Description of Alternatives

Alternative No. 1 - No Action (Future Without Project)

This alternative would require no project action. Conservation practices would be installed through the ongoing program over a 30 year period. Approximately 1,379 acres of new reservoirs would be constructed. Reservoir construction is limited by the available runoff of the drainage area. The aquifer would continue to be depleted and approximately 174,593 acres of irrigated cropland would revert to dryland farming. This alternative does not meet the objectives of the sponsors.

Alternative No. 2 - Conservation/Storage Alternative

This alternative would accelerate installation of conservation practices in the project area during a five year period. Approximately 1,379 acres of new reservoirs would be constructed. Reservoir construction is limited by the available runoff of the drainage area. The aquifer would continue to be depleted and approximately 174,593 acres of irrigated cropland would revert to dryland farming by the year 2055. This alternative does not meet the objectives of the sponsor.

Alternative No. 3 - Conservation/Storage/Alternate Surface Source Alternative (Recommended Plan)

This alternative would accelerate the installation of conservation practices in the project area during a 13 year period. Installation of a delivery system would occur during that same period. Approximately 8,849 acres of new reservoirs would be installed. Reservoir construction would not be limited by runoff from the project area. About 238,707 acres of irrigated cropland would remain in production. This alternative would meet the objectives of the sponsor.

Effects of Alternatives

The following section describes the economic, environmental, and social effects of each alternative. Concerns listed in Table 5 with a high or moderate degree are described. A brief description of some concerns not significant to formulation is also included due to federal laws, regulations, or special interests. The effects of the Without Project Action were discussed previously in the "Setting" and "Problems" sections.

Wildlife Habitat - Existing Conditions

Wildlife distribution and populations depend largely on the quantity and quality of available habitat. Habitat conditions are in turn influenced by land use, land management, distribution of water, climate, human influences, and other limiting factors. Wildlife populations are directly proportional to the availability and suitability of their habitat requirements. Wildlife species are opportunistic in obtaining necessary requirements for life. The most favorable habitat condition for terrestrial wildlife is a mixture of vegetative cover types that are all within the home range of the various species. Diversity is an important element of productivity.

The land use of the project area has been placed into five categories. Table 2 illustrates these land uses and the respective acreages and percentages of each. Wildlife habitat can best be described in terms of vegetative cover types. From the five land use categories, three general vegetative cover types can be delineated to describe the terrestrial wildlife habitat of the project area.

Forested habitat covers 42,313 acres and is the second largest cover type in the project area. Both wooded wetlands and upland communities were taken into consideration. Species composition varies according to soil type, moisture conditions, slope aspect, and other limiting factors.

Dominant upland forested community types that occur within the project area are as follows:

- (1) Post Oak-Hickory sp.
- (2) Post Oak
- (3) Post Oak-Hickory sp.- Co-dominant

Co-dominants vary with soil types, moisture levels, slope aspect, and other limiting factors. (e.g. Post Oak-Hickory sp.-White Oak)

Woodland habitat provides all or some life requisites for many wildlife species. Wildlife species or groups that rely on forested habitats include white-tailed deer, fox squirrels, gray squirrels, southern flying squirrel, woodchuck, eastern cottontail rabbits, swamp rabbits, eastern spotted skunks, striped skunks, river otters, bobcat, mink, raccoon, coyote, ninebanded armadillo, foxes, mice, rats, wild turkeys, woodpeckers, owls, hawks, and song birds including nuthatches, warblers, and chickadees. Several species of reptiles and amphibians are also included.

Grassland is the third most abundant cover type and includes 4,571 acres of native prairie, native pasture, and improved pasture land. Species composition varies according to soil type, moisture condition, and management practice. Well-managed native range or pasture is a mixture of tall grasses composed principally of big bluestem, little bluestem, switchgrass, and Indiangrass. These areas may also include numerous forbs. If not managed properly, broomsedge, silver bluestem, splitbeard bluestem, and ragweed may become dominant. Invasion of woody species may also occur in this area. Sweetgum, ash, sumac, and persimmon are among the early successional series that invade unmanaged fields in this area. Introduced pasture in the basin consists mainly of bermudagrass.

Wildlife species or groups commonly associated with seasonal herbland include white-tailed deer, rabbits, skunks, coyotes, fox, mice, rats, bob-white quail, birds of prey, songbirds, reptiles, and amphibians.

Cropland is the dominant cover type and consists of 254,406 acres of seasonal crops requiring frequent or seasonal tillage, intensive management practices, or both. Crops within the basin include wheat, soybeans, rice, grain sorghum, and corn. Wildlife species rely heavily on croplands as a food source due to the abundance of insect species and the actual crops grown. Some species or groups that are commonly encountered in the cropland cover type and the adjacent edge communities include white-tailed deer, rabbits, raccoons, fox, mice, rats, wild turkey, bob-white quail, mourning doves, flycatchers, sparrows, birds of prey, waterfowl, and a number of shore birds.

Alternative No. 1 - No Action

Approximately 1,379 acres of reservoirs will be constructed. No additional land is expected to be cleared for agricultural purposes. Some land may be cleared for urban activities, road construction, and utility right of ways. Additional wildlife habitat loss will need to be considered in stream and riverine systems. Without the project, surface water use will increase due to loss of available groundwater therefore it will adversely impact existing conditions.

If sloped bottoms are incorporated in reservoir design, these reservoirs could mean additional habitat for numerous species of shore birds that migrate through the area each year. On the downside without the project, availability of water will reduce habitat for both shore birds, waterfowl, and other water-dependent species.

Alternative No. 2 - Conservation/Storage

The construction of 1,379 acres of reservoirs will delay the uptake of surface water in certain areas of the project area. The aquifer will continue to be depleted and habitat loss is expected to continue.

Alternative No. 3 - Conservation/Storage/Alternate Surface Source

The construction of 8,849 acres of reservoirs in the area and the continued irrigation of 238,707 acres of existing croplands will provide wildlife habitat, food sources, and water for waterfowl, shore birds, and other cropland dependent species. Demands for groundwater will be decreased due to increased availability of surface water.

Wetlands - Present Conditions - Wetland habitats that would be disturbed by construction were grouped into six categories:

- (1) Bottomland Hardwoods (Dominated by woody vegetation greater than 6 meters tall).
- (2) Forested Swamps (Dominated by woody vegetation greater than 6 meters tall).
- (3) Scrub/Shrub Swamp (Dominated by woody vegetation less than 6 meters tall).
- (4) Emergent Wetland (Dominated by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens).
- (5) Riverine (Deep water systems bound by banks on each side)
- (6) Impoundments (Reservoirs, Lakes, Fish Ponds)

An interagency group composed of biologists from the U.S. Fish & Wildlife Service (USFWS), Arkansas Game & Fish Commission (AG&FC), MDCOE, and NRCS agreed upon the groups and conducted the habitat evaluations.

These aquatic communities are extremely high in species diversity and provide essential habitat for many water-oriented species. Included among these species are groups of



Photograph 1 - Interagency team conducting habitat evaluation.

ducks, geese, herons, egrets, shore birds, songbirds, birds of prey, raccoons, rabbits, beavers, muskrats, white-tailed deer, reptiles, and amphibians.

Alternative 1 - No Action

Wetland communities in the project area will be degraded due to the increasing use of surface water. The natural water regime that wetland communities are dependent upon will be manipulated, causing major impact on all wetland communities. Without adequate water the natural systems will cease to function and the composition of the wetland communities could change.

Alternative No. 2 - Conservation/Storage

The construction of 1,379 acres of reservoir in the project area would mean a delay in the surface water uptake from waterways. Wetland communities in the project area will be degraded due to the increasing rates of surface water uptake. The natural water regime that wetland communities are dependent upon will be manipulated, therefore causing major impact on all wetland communities. Without the amounts of

water needed for the natural systems to function the composition of the wetland communities could be changed.

Alternative No. 3 - Conservation/Storage/Alternate Surface Source

The construction of 8,849 acres of on farm reservoirs will provide irrigation water for some 238,707 acres of irrigated cropland and will minimize the use of both groundwater and surface water from waterways. Existing wetlands will be preserved with these functional components in place. High quality natural communities such as the Smoke Hole Natural Area will not be adversely impacted by irrigated farm practices.

Fishery - Existing Conditions - On-farm fishery habitat consists of manmade ditches, streams, reservoirs, and lakes. Approximately 15,566 acres of irrigation reservoirs provide fair to good quality fish habitat. Many local fishermen have quit fishing traditional fishing spots and now go to irrigation reservoirs because of the fishing success. Key factors for a good fishery are maintaining a minimal water depth and providing habitat (rock piles, tire reefs, or brush piles).

Joint fish sampling was conducted by the AG&FC, MDCOE, and NRCS on an irrigation canal September 1st and 2nd, 1994. The site sampled was similar to a long pond or reservoir because water was not flowing at the time of the sample. The rotenone sample yielded seventeen species of fish including bluegill, redear sunfish, black crappie, warmouth, spotted gar and gizzard shad. The sample approximates species found in a farm pond or irrigation reservoir.

Alternative No. 1 - No Action

Waterways in the project area will continue to be degraded by over pumping of the water for irrigation purposes. Degrading the water quality will mean a decrease in productivity levels in the food chain. The 1,379 acres of reservoir could create additional habitat with farmers cooperation. Farmers are unlikely to maintain minimal water levels without adequate supply.

Alternative No. 2 Conservation/Storage

Same as alternative No.1.

Alternative No. 3 - Conservation/Storage/Alternate Surface
Source

The addition of 8,849 acres of reservoirs could mean more acres of productive fisheries with cooperation of farmers. Design of new reservoirs would include sloped bottoms, deeper area in the middle, artificial fish structures, and wave control features for shorelines. Water quality of existing waterways will improve productivity levels.

Endangered and Threatened Species - Existing Conditions - The Arkansas Natural Heritage Commission (ANHC), AG&FC, and the U.S. Fish and Wildlife Service (USFWS) records revealed that no federally listed endangered and/or threatened species occurred in the project area.

Alternative No. 1 - No Action

No change in the status of endangered and threatened species is likely to occur.

Alternative No. 2 - Conservation/Storage

No change in the status of endangered and threatened species is likely to occur.

Alternative No. 3 - Conservation/Storage/Alternate Surface
Source

No change in the status of endangered and threatened species is likely to occur.

Waterfowl/Shore birds - Existing Conditions - Arkansas has long been considered to be one of the "Meccas" for waterfowlers throughout the continent. This has resulted from a number of factors including its location at the heart of the wintering range for the Mississippi Flyway, its historically abundant wetland resources, and its ranking as the most important wintering state for mallards in the country. (Yaich) Mallards, pintails, and black ducks typically comprise 2/3 to 3/4 of the harvest in the state. To illustrate the importance of Arkansas from a waterfowl harvest and hunter activity perspective, some national rankings for Arkansas' 1988-89 waterfowl season are as follows (for comparison, Arkansas ranked 33rd in total population in the 1980 census):

Mallard harvest.....	1st
Total duck harvest.....	5th
Wood duck harvest.....	5th
Days hunted/adult hunter.....	3rd
Ducks/adult hunter day.....	4th
Ducks harvested/adult hunter (season)....	1st

These statistics not only provide support for the statement that Arkansas is one of the most important harvest areas for ducks in the country, but are evidence of the biological importance of Arkansas in providing for the needs of wintering waterfowl. Midwinter survey records indicate that during the 1970s an average of 5.23 percent (1.06 million) of all ducks counted in the nation were observed in Arkansas. The average count of mallards during this period was 919,000, approximately one-third of the Mississippi Flyway's total. It is clear that Arkansas plays as dominant a role in the provision of mallard wintering habitat as it does in harvest. (Yaich)

The principal habitats utilized by waterfowl, such as bottomland hardwoods, scrub-shrub swamps, irrigation reservoirs, moist-soil areas, etc., fall into three general habitat categories. These basic categories are: (1) unmanaged, naturally ponded or flooded habitat; (2) public managed habitat; and, (3) private managed habitat. While acreage included in the managed categories already contributes, in a reliable way, to the annual habitat needs of wintering waterfowl, land in the unmanaged category provides habitat only when flooded by natural overflow. One basic habitat problem is that wintering waterfowl are currently dependent upon this unmanaged habitat for the provision of a very significant portion of their needs, particularly for foraging. Although flooding is common, it cannot be relied upon to occur annually, and its duration and extent is highly variable. (Yaich)

Shore birds- Approximately 25 species of shore birds migrate through the state of Arkansas each year. In addition to these there are two local species and seven infrequent visitors in the state. This magnificent group of birds are heavily sought after each spring and fall by hundreds of birders. The majority of the birds migrate through eastern Arkansas utilizing drying reservoirs and mudflats for food and cover. Surface water reservoirs with a moderate slope along the bottom provide excellent habitat. These reservoirs exhibit sizable areas of shallow water with high levels of invertebrates. Invertebrates are critical forage for shore birds due to their high protein levels. Reservoirs in this region provide habitat for shore birds that is essential during their migration through the state.

Alternative No. 1 - No Action

Approximately 16,249 acres less rice will be produced without the project. Levees will be closed after harvest on all of the remaining 71,584 acres of rice to capture rainfall. This water will be pumped back to surface reservoirs. None of the 71,584 acres will be flooded for waterfowl. None of the soybeans will be irrigated or leveed and flooded for

waterfowl. One-thousand, three-hundred and eighty acres (1,380) of new reservoirs will be constructed to capture surface runoff for irrigation purposes. These new reservoirs will provide resting habitat for waterfowl and mud flats for shore birds.

Alternative No. 2 - Conservation/Storage

Same as 1.

Alternative No. 3 - Conservation/Storage/Alternate Surface Source

Approximately 238,707 acres of irrigated cropland will remain in production. An additional 8,849 acres of reservoirs will be installed. The District will provide incentives for 45,000 acres of habitat to be flooded annually from November 1 to March 1. An additional 30,000 acres of cropland has the potential of being flooded from water collected from rainfall. Additional forage means healthier waterfowl during the late winter months, which is critical for the migration to breeding grounds.

If sloped bottoms are incorporated in reservoir design, these reservoirs could mean additional habitat for numerous species of shore birds that migrate through the area each year. On the downside without the project, availability of water will reduce habitat for both shore birds, waterfowl, and other water-dependent species.

Natural Areas - Existing Conditions - Three natural areas including Railroad Prairie, Konecny Prairie/Konecny Grove, and Smoke Hole Natural Area, occur in the watershed. The ANHC either holds fee title or a conservation easement on these areas. These areas are managed by ANHC to protect their natural features and their high species diversity. (ANHC Report)

The Railroad Prairie occupies portions of the abandoned right-of-way of the former Chicago, Rock Island and Pacific railroad. The total area of the right-of-way is 318 acres, of which about 150 acres is covered with prairie vegetation of fair to excellent quality. This prairie is the largest remaining remnant of the Grand Prairie and its linear configuration encompasses a greater number of communities than any other tract. Six species of plants listed by the ANHC as "Special", two former review plant species listed by the USFWS, and numerous occurrences of the prairie mole cricket (formerly a federal review species) occupy this feature. (ANHC Report)

Konecny Prairie and Konecny Grove comprise a 50.84 acre tract of land with the prairie occupying 28.67 acres of the total. Konecny Prairie is the largest block remnant remaining of the

Grand Prairie Grassland with most of the typical grasses and forbs. It is the only known place in the State where a prairie and a grove are in close proximity. The grove, one of few remaining examples of prairie slash, is significant as the habitat in which the willow flycatcher was first discovered.

Smoke Hole Natural Area is a 437 acre tract of land straddling the Lonoke-Prairie county line. The name "Smoke Hole" actually refers to a small opening in an otherwise densely associated stand of an area which supports a near exclusive stand of water tupelo. The tupelo is surrounded by a mature bottomland hardwood forest. The remainder of the tupelo trees are densely associated, and they form a maze of confusion because of their uniform size and growth habit. An unusual feature of this tupelo brake is the complete absence of bald cypress. (ANHC Report)

Alternative No. 1 - No Action

Further depletion of the aquifer will increase the uptake of surface water from existing waterways. Withdrawal of large quantities of water from Two Prairie Bayou for irrigation of crops during extremely dry summers could have a drastic effect on Smoke Hole Natural Area. This water tupelo community is highly dependent on standing water and a shift in species composition may occur with long term dry out.

Alternative No. 2 - Conservation/Storage

The impact of this alternative will be the same as Alternative 1.

Alternative No. 3 - Conservation/Storage/Alternate Surface Source

The installation of on-farm conservation and water management practices will reduce demand on existing streams.

Recreation - Existing Conditions - The large number of waterfowl that winter in the state has produced a great waterfowling tradition on the part of both resident and non-resident hunters over the years. Additionally, enthusiasm for waterfowl hunting has resulted in the production of an economic benefit for the state proportionally larger than for other types of hunting. For example, in 1985, Arkansas residents spent an estimated \$30 million for expenditures related to migratory bird hunting. In addition, the tradition of Arkansas as the most important wintering area for mallards in the country, coupled with the mallard's reputation as the duck of choice for most waterfowlers, has led to a significant flow of non-resident hunters (with their attendant economic benefits) into the state. Non-residents brought a conservatively-estimated \$7.3 million into the

state for trip-related expenses (gas, food, lodging) alone in 1985. And, a larger proportion of the total migratory bird hunting in the state was conducted by non-residents (22%) than for any other type of hunting. (Yaich)

Shore birds- Approximately 25 species of shore birds migrate through the state of Arkansas each year. In addition to these there are two local species and seven infrequent visitors in the state. This magnificent group of birds are heavily sought after each spring and fall by hundreds of birders. The majority of the birds migrate through eastern Arkansas utilizing drying reservoirs and mudflats for food and cover. Surface water reservoirs with a moderate slope along the bottom provide excellent habitat. These reservoirs exhibit sizable areas of shallow water with high levels of invertebrates. Invertebrates are critical forage for shore birds due to their high protein levels. Reservoirs in this region provide habitat for shore birds that is essential during their migration through the state.

Alternative No. 1 - No Action

Approximately 1,379 acres of new reservoirs would be constructed. These reservoirs would provide limited resting and shelter areas for wildlife. Intense competition to capture runoff to fill these reservoirs would reduce naturally flooded areas. The use of field levees to slow runoff would provide some positive benefit.

Approximately 174,593 of irrigated cropland would revert to dryland farming by the year 2030. Crop yield and the associated wildlife food source would be significantly reduced as wasted grain is a percentage of yield.

Alternative No. 2 - Conservation/Storage

Approximately 1,379 acres of new reservoirs would be constructed. Economic incentives would allow specialized construction to enhance wildlife use. Intense competition to capture runoff to fill these reservoirs would reduce naturally flooded areas. The use of field levees to slow runoff would provide some positive benefit.

Approximately 174,593 of irrigated cropland would revert to dryland farming by the year 2055. Crop yields and the associated wildlife food source would be significantly reduced as wasted grain is a percentage of yield.

Alternative No. 3 - Conservation/Storage/Alternate Surface Source

Approximately 8,849 acres of new reservoirs would be installed. Economic incentives would allow specialized construction of these reservoirs to enhance wildlife use. The use of field levees to improve capture would provide positive benefits. Conservation plans would include a fish and wildlife component. Crop yields and thus the waste grain for wildlife food source would be maintained on 238,707 acres of irrigated cropland.

Water Quality - Existing Conditions - All waters within the project area have been designated for propagation of fish and wildlife; primary and secondary contact recreation; and domestic, agricultural, and industrial water supply. No surface waters are designated as outstanding state or national resource waters (50).

Little water quality data exists on streams within the project area. The closest surface water monitoring sites reflective of stream water quality in the Grand Prairie project area are Bayou Meto near Bayou Meto, Wattensaw Bayou near Hazen, and Bayou DeView near Gibson (53). Data from these stations are illustrated in Appendix ###.

Surface water quality is primarily influenced by soils, topography, land use, and hydrologic modification. Streams typically are high in suspended solids, turbidity, bacteria, phosphorus, and total organic carbon. The station on the White River near DeValls Bluff is close to the diversion point and represents the quality of imported water. A comparison of diverted water to the existing water quality of area streams, during 1992 and 1993 illustrates that water to be diverted is of better quality than what exists today in the Grand Prairie (50). With the exception of hardness, all parameters including chlorides, sulfates, turbidity, total organic carbon, and nutrients were higher in Bayou Meto, Wattensaw, and Bayou DeView than the water to be diverted. Chlorides averaged 4.17 mg/L but do not cause a problem to crops when less than 70 mg/L. Sulfates averaged 7.2 mg/L and usually do not result in irrigation problems until they exceed 100 mg/L (54). Hardness in White River water typically was twice as high as the streams that originate in the delta. The White River averaged 131.58 mg/L while Bayou Meto, Wattensaw and DeView ranged from 70 to 83 mg/L. The White River originates in the sandstone and shales of the Boston Mountains but meanders for hundreds of miles through the carbonates and dolomites of the Springfield and Salem Plateaus. Hardness results from the solution of calcium carbonate and magnesium from rocks of these plateaus. Concentrations of calcium and magnesium are sufficient to classify the White River water as "hard" but not high enough

to cause soil or plant problems (52). The long term use of this water should not cause a salinity problem on seedling rice. No hazards should be anticipated when this water is used for rice and soybean irrigation (51).

In summary, the water to be diverted is generally of better quality than the existing water quality on the Grand Prairie and is fully suitable to irrigate crops without detrimental effects to the plants or the soil.

Alternative No. 1 - No Action

Water quality would continue to be degraded in natural streams by the reduction of flow due to increased withdrawals and field runoff.

Alternative No. 2 - Conservation/Storage

Water quality would continue to be degraded in natural streams by the reduction of flow due to increased withdrawals and field runoff.

Alternative No. 3 - Conservation/Storage/Alternate Surface Source

Water quality in natural streams would be improved by the introduction of higher quality White River water into the natural system. Maintaining flows during hot, dry periods would reduce stagnation and increase dissolved oxygen content. Tailwater recovery systems would reduce field runoff to natural streams.

Ground Water - Existing Conditions

Alternative No. 1 - No Action

Groundwater levels will continue to decline with increasing dependence upon deep aquifers and surface water. Storage in the alluvial aquifer was 16,369,286 acre feet in 1992 with declines projected to reach 15,384,160 acre feet when the aquifer reaches equilibrium under 2030 pumping stresses.

Alternative No. 2 - Conservation/Storage

Accelerated practice implementation would slow the rate of decline in the aquifer but the result would be about the same. When the aquifer reaches equilibrium, storage would be approximately 15,400,000 acre feet.

Alternative No. 3 - Conservation/Storage/Alternate Surface Source

With implementation of conservation practices, reservoirs, imported surface water and groundwater use limited to 35,574 acre feet per year, the aquifer would rebound with normal recharge. Declines would continue during initial implementation but reverse in five years to rebound conditions. The safe yield in the Grand Prairie is approximately 124,000 acre feet per year. The surplus would recharge the aquifer to about 17,281,000 acre feet by the year 2030.

Cultural Resources

Cultural impacts will vary depending on the size and location of irrigation field ditches, tailwater recovery systems, storage reservoirs, and underground pipelines. None of the known historic and pre-historic archaeological properties will be adversely affected.

Cultural resources surveys will evaluate the effects of the plan on the resources in areas to be disturbed. Given the long use of the project area by man, it is likely that sites will be discovered. Many of these have been previously disturbed by agricultural activities and may no longer contain significant information. However, all will be evaluated by an archaeologist with reference to the National Register of Historic Places criteria and to their ability to contribute to the goals of the Arkansas State Plan.

Alternative No. 1 - No Action

This alternative will require no project action, but cultural resources will be considered for the on-going conservation practices. These cultural resource considerations, with resulting evaluations, will be according to procedures set forth in the "State Level Agreement Between the NRCS and the Arkansas State Historic Preservation Officer".

Alternative No. 2 - Conservation/Storage

Conservation practices will require cultural resource consideration and evaluations according to the State Level Agreement described above.

Alternative No. 3 - Conservation/Storage/Alternate Surface Source

Conservation practices will require cultural resource considerations according to the State Level Agreement; the project delivery system will require cultural resource evaluations by an archaeologist with regard to the National

Register of Historic Places. Significant cultural resources will be avoided or preserved in place to the fullest practical extent.

Disadvantaged Groups, Minorities, Women, and Persons with Disabilities - Existing Conditions It is estimated that disadvantaged groups consist of 304 women, 37 minority, 110 limited resource farm owners and operators in the project area.

Alternative No. 1 - No Action

Disadvantaged groups would be proportionally impacted as other groups as cropland is converted to dryland operations. Persons with limited resources would be less able to adjust and probably would not be able to construct reservoirs.

Alternative No. 2 - Conservation/Storage

These groups would be affected as under Alternative 1, taking into account the difference in time frame for the construction of the 1,379 acres of reservoirs.

Alternative No. 3 - Conservation/Storage/Alternate Surface Source

Conservation Plans will be developed with minority landowners. Sixty-five percent cost-share rates should allow a higher than average number of minority farmers to participate in the project.

Important Agricultural Land - Existing Conditions - There are 247,556 acres of cropland that are currently irrigated within the project area.

Alternative No. 1 - No Action

Irrigated land will decrease from approximately 247,556 acres to 71,584 acres. About 174,593 acres would be operated on a dryland basis while 1,379 acres would be converted to reservoir. This would occur over a fifty year period.

Alternative No. 2 - Conservation/Storage

Irrigated land will decrease from approximately 247,556 acres to 71,584 acres. About 174,593 acres would be operated on a dryland basis while 1,379 acres would be converted to reservoir. This would occur over a five year period.

Alternative No. 3 - Conservation/Storage/Alternate Surface Source

There would be a loss of 8,849 acres important agricultural lands due to conversion to reservoirs as a part of the on-farm portion of the project.

Social and Economic Effects - Existing Conditions - Currently about 250,000 acres of cropland are irrigated and serve as the base for the economy of the area. Production of rice, soybeans, corn, and grain sorghum generate approximately \$71 million in purchases annually of supplies and equipment for use in production and marketing of the crops. In addition the strong economic contribution of the recreation industry based primarily on hunting, fishing, and nonconsumptive wildlife expenditures contribute approximately \$760 million annually, according to the 1991 National Survey of Fishing, Hunting and Associated Recreation.

Alternative No. 1 - No Action

Under this alternative 174,593 acres of cropland would revert to dryland farming by 2030. Approximately 1,379 acres would be converted to reservoirs. Crop production expenses would be reduced by \$20,000,000 which would adversely affect the agricultural economy of the area.

Alternative No. 2 - Conservation/Storage

Under this alternative about 174,593 acres of cropland would revert of dryland farming by the year 2055. This would mean a reduction in annual ownership and operating expenditures in the area of some \$20 million.

Alternative No. 3 - Conservation/Storage/Alternate Surface Source

This alternative would maintain production on 238,707 acres. A total of 8,849 acres would be converted to reservoirs. This would generate a benefit of reduced on-farm energy costs of \$6,576,000 and increased yields due to use of surface water of about \$2,946,600. A labor benefit during construction of the project would amount to \$ \$675,000. In addition this alternative would continue the high level of production that would keep the economy of the area on a high level.

Increased economic activity accruing to the agricultural community from operation and ownership cost would amount to nearly \$20,000,000 annually.

The enhancement of the waterfowl and fishery habit will result in more sustained hunting and fishing as well as the nonconsumptive recreation activities.

Limited resource and/or minority farmers - Existing Conditions - Currently there are 110 limited resource and /or minority farmers in the project area.

Alternative No. 1 - No Action

Without project action these farmers will be severely pressed as the availability of irrigation water declines and greater economic pressure is exerted. Continued operation will be difficult.

Alternative No. 2 - Conservation/Storage

The impact of this alternative will be the same as alternative 1.

Alternative No. 3 - Conservation/Storage/Alternate Surface Source

Limited resource and minority farmers would be able to participate in the project through the cost share programs under this project .

Relationship of the Alternatives to Local and Regional Comprehensive Plans and Land and Water Use Plans, and Controls.

The ASWCC was authorized by Act 217 of 1969 to write a state water plan. The act gave the Commission responsibility for water resources planning at the state level and for the creation of a master plan to serve as the primary water policy document for the state of Arkansas. The water plan provided criteria for the delineation of critical groundwater areas and outlined a strategy to correct the widespread groundwater overdraft problems in the state. The critical groundwater area criteria for unconfined aquifers such as the alluvial aquifer in the project area was established at a decline rate of at least one foot per year for a period of 5 years and/or less than 50 percent of the saturated thickness remaining in the aquifer.

The problems of groundwater overdraft were addressed in the 1985 General Legislative Session with passage of Act 417, entitled "Water Resource Conservation and Development Incentives Act of 1985." This act stated that existing water use patterns were depleting underground water supplies at an unacceptable rate because alternative surface water supplies were not available in sufficient quantities and quality at the time of demand. The act provided groundwater conservation incentives in the form of state income tax credits to encourage the construction and restoration of

surface water impoundments and conversion from groundwater based irrigation systems to surface water withdrawal and delivery systems.

Beneficial or Adverse Effects on Identified Wetlands and How These Effects Relate to the Wetland Conversion Provisions of the Food Security Act.

Although 8,849 acres of storage reservoirs will be constructed on existing cropland, none of the reservoirs will be constructed on wetlands as defined by Food Security Act, (i.e., Farmed Wetlands); therefore, there will be no negative impact on wetlands. However, 8,849 acres of additional surface water will be created and used by waterfowl for winter resting. These reservoirs will also have shorelines suitable for use by wading shore birds. Animals will also benefit from the additional surface water. Levees maintained with vegetation will provide additional forage and cover for wildlife species.



Photograph 2 - Reservoirs provide suitable habitat for waterfowl and shore birds.

Relationship Between Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity.

Conversion of 8,849 acres of cropland will result from the construction of tailwater recovery systems and storage reservoirs. This conversion will provide an adequate supply of irrigation water to sustain agricultural production without depleting the groundwater resource base.

Executive Order 11990 - Protection of Wetlands.

All storage reservoirs will be constructed on existing cropland; therefore, no wetlands as defined by Food Security Act, (i.e., Farmed Wetlands) will be lost.

Irreversible or Irretrievable Commitments of Resources.

An estimated 1,379 acres of cropland will be permanently converted to reservoirs under Alternative 1 and Alternative 2. Under Alternative 3, 8,849 acres will be permanently converted to ditches and reservoirs. Agricultural production will be lost on this acreage. The commitments of labor, fuel, machinery, and materials to the project will be irretrievable.

Comparison of Alternative Plans

Two alternatives are compared in this section: Alternative No. 1 - No-Action, Alternative No. 3 - Conservation/Storage, and Alternative No. 3 - Conservation/Storage/Alternative Source.

Table 4 displays the four accounts addressed in "Principles and Guidelines." A summary of all major items used in the decision-making process is shown. The measures used in each alternative and a comparison of effects are included. Alternatives that could be recommended are called candidate plans. Alternatives 1 and 3 are candidate plans.

TABLE 4
Summary and Comparison of Candidate Plans
Grand Prairie Irrigation Project

Effects	Without Project Action	Alternative 2 Conservation / Storage	Alternative 3 Conservation / Storage Alternate Source (Recommended Plan)
Measures	Practices installed thru on-going program over 30 yrs. Approx 1380 new res constructed. Aquifer cont to deplete. Aprox 174,593 of irrigated cropland would revert to dry farm by yr 2030.	Accelerated installation over 5-year period. Appox 1380 new res constructed. Aquifer cont to deplete. Aprox 174,593 acres of irrigated cropland revert to dry farming by yr 2055.	Installation of cons practices over 13 yrs. Delivery sys installed Approx 238,707 acres irrigated cropland remain in production.
NATIONAL ECONOMIC DEVELOPMENT ACCOUNT (Dollars)			
Beneficial Annual			\$10,329,000
Adverse Annual			\$13,513,000

TABLE 4 (cont'd.)

Summary and Comparison of Candidate Plans

Grand Prairie Irrigation Project

Effects	No Action-Alternative 1	Alternative 2	Alternative 3
Measures	None		
ENVIRONMENTAL QUALITY ACCOUNT			

Air Quality	No significant change.	No significant change.	Reduction of dust.
Waterfowl / Shore birds	Reduction of aquatic habitat due to surface water uptake.	Same as 1.	Potentially, additional habitat for waterfowl, shore birds, and other water-oriented species.
Grassland	No significant change.	Same as 1.	Minimal Impact on Railroad Prairie.
Wetland	Possible degradation of all wetland communities, due to uptake of surface water through irrigation.	Same as 1.	Decrease of surface water uptake, therefore preservation of existing wetland communities.
Agricultural Land	Reduction in irrigated crop production.	Addition of 1,379 acres of reservoirs for containment of surface water runoff.	Continued crop production on 238,707 acres. Approx. 8,849 acres of additional reservoirs.

TABLE 4 (cont'd.)

Summary and Comparison of Candidate Plans

Grand Prairie Irrigation Project

Effects	No Action-Alternative 1	Alternative 2	Alternative 3
Measures	None		
ENVIRONMENTAL QUALITY ACCOUNT			
Fish Habitat	Degraded water quality, lowering primary productivity.	Same as 1.	Improved water quality; 8,849 acres potential habitat.
Cultural	Cultural resources neither affected nor identified in project area.	Significant cultural resources avoided or preserved by farm practices.	Same as 2.
Threatened & Endangered	No significant change.	Same as 1.	Same as 1 & 2.
Water Quality	No significant change	Same as 1	Improved water quality
Wooded upland	No significant change.	Same as 1.	Same as 1 & 2.
Wetlands adjacent to ditches	Possible summer/fall dry out, due to uptake of surface water. Change in species composition.	Same as 1.	Decrease in water uptake; therefore reduce impact of irrigated farm practices.

Risk and Uncertainty

Risk involves potential outcomes that can be described in reasonably well known probability distributions; whereas, uncertainty cannot be described in objectively known probability distributions. The project would transform the uncertainty of weather patterns (i.e., rainfall distributions) as the sole source for crop production and waterfowl nesting and to a risk situation by importing water from the White River. This would reduce the variability of incomes in the area that would become more pronounced in the event the area reverted to dryland agriculture. Probabilities of adequate water supplies with project installation can be established.

Rationale for Plan Selection

After analyzing the candidate plans, it was determined that Alternative 3, the water conservation, storage, and alternate source plan was the only plan acceptable to the sponsors. It passes the four tests of completeness, effectiveness, efficiency, and acceptability. The no-project plan does not satisfy the sponsors goals or project goals. The summary of effects and comparison shown in Table 4 becomes the recommended plan.

CONSULTATION AND PUBLIC PARTICIPATION

Agencies notified of intentions to plan a project were the State Clearinghouse, Arkansas Highway and Transportation Department (AHTD), ANHC, Arkansas Department of Pollution Control and Ecology, AG&FC, USFWS, and Little Rock District Corps of Engineers.

NRCS coordinated closely with representatives of the ASWCC, AG&FC, ANHC, USFWS, MDCOE, and Ducks Unlimited. Numerous meetings were held with these agencies on fish and wildlife resources, waterfowl, shore bird management in reservoirs, zebra mussel control, wetlands, and prairie restoration.

April 2, 1996 Fishery w/ MDCOE & AG&FC
March 21, 1996
Jan 19, 1995
Nov 29, 1994
Oct 18, 1995 Memphis
Sept 25, 1995 Interagency Tour Prairie Restoration
March 15, 1995 Interagency Tour and Field
April 13, 14, 1994 Vicksburg Meeting with AG&FC and USFWS
September 14, 1994 AG&FC Briefing
July 13, 1994 White River Allocation Meeting
Nov 18, 1993 MDCOE Meeting in Memphis
July 27, 1993 Interagency Tour
August 17, 1993 Interagency Tour

RECOMMENDED PLAN

The recommended plan is presented in the following section. This section describes measures to be installed, (both structural and nonstructural), permits required, costs, installation and financing, operation and maintenance, and economic benefits.

The purpose of the plan is to develop a strategy to protect the groundwater resources of the area while supplying agricultural water for irrigation, fish farming, and the enhancement of fish and wildlife habitat. The recommended plan consists of two primary components: a delivery system component and an on-farm water management component.

The delivery system will consist of a pumping plant located on the west bank of the White River approximately one half mile north of DeValls Bluff and a series of canals, streams, and pipelines which will transport water to individual farms within the project area.

The on-farm water management component of the plan will consist of the installation of one or more Best Management Practices (BMP's) which will improve irrigation efficiencies, provide any necessary storage, improve reliability, and/or retrofit existing irrigation systems to utilize the delivery system.

This document addresses only the on-farm component of the plan and will be included as part of the overall project plan to be prepared by the MDCOE. The delivery system component of the plan will also be addressed by the MDCOE in the overall project plan.

The problem area consists of 247,556 acres of irrigated cropland and 3,070 acres of fish ponds within the project area. It is estimated that 82 percent of the agricultural water supply of the problem area is taken from groundwater. The other 18 percent comes from surface water sources. The entire problem area is at least partially dependent on groundwater during drought years and will benefit from protection of the groundwater resource.

The recommended plan will provide an adequate supply of water approximately 8 out of 10 years with only limited damages during the other years. A detailed analysis of river availability has been conducted by the MDCOE and the reliability of the delivery system will be addressed in the overall project plan.

The irrigation water will be supplied from on-farm irrigation reservoirs (30 percent), natural runoff/tailwater recovery (11 percent), groundwater (7 percent), and the delivery system (52 percent).

A simplified version of the operation plan is:

January - April Fill reservoirs from natural runoff (57%)
and from delivery system (43%).

May - September Irrigate cropland. Priority for use:

1. Runoff/tailwater
2. Import water
3. Reservoir water
4. Groundwater

October Maintenance

November- December Flood cropland for waterfowl feeding
and resting areas.

The sponsor, the White River Regional Irrigation Water Distribution District (WRIWDD), will own, operate, and maintain the delivery system. It will be the sponsor's responsibility to acquire all easements and right-of-ways in order to deliver water to individual properties within the project area. The sponsor will have the right of eminent domain.

Use of water from the delivery system will be voluntary, but the District is supporting legislation which would allow assessing baseline benefits to all cropland within the project area. These baseline benefits will be recovered in the form of a tax or annual membership fee and will be utilized to defer some of the costs of owning the system. Other costs will be recovered through the sale of water.

Participation in the on-farm program will be voluntary. Individuals wishing to participate will work with the District and the NRCS to develop a "Water Management Plan". This plan will detail the practices to be installed and will include an "Operation Plan" which will improve the reliability of having an adequate water source. The landowner will make the final decision on practices to be installed and on the operation of his on-farm irrigation system.

Individual landowners will own, operate, and maintain the on-farm components of the project. They will be responsible for management of their system, however, withdrawal of water from the delivery system will be limited to allocation amounts during peak use periods.

On-farm Measures to be Installed

Underground Pipelines - Approximately 630 miles of new permanent underground pipelines with appurtenances will be placed in existing irrigated fields to prevent loss of water quality and quantity. Such pipelines will allow the proper management of water and eliminate conveyance losses caused by evaporation and seepage.

Tailwater Recovery Systems - Approximately 675 miles of new tailwater recovery canals will be installed to collect, store, and transport runoff and tailwater for reuse on the farm. Tailwater recovery systems will improve water management and water quality.

Storage Reservoirs - Approximately 8,849 acres of new storage reservoirs will be constructed to conserve water by holding it until it can be used beneficially to meet crop irrigation requirements. Reservoirs will also be utilized to ensure adequate delivery rates during peak use periods. The reservoirs will be filled from runoff, tailwater, and the delivery system. The estimated amount of additional storage needed for individual operating units was determined in the water budget analysis. Final design volumes will be determined during the development of the "Water Management Plan".

Reservoirs will generally be completely enclosed and will be filled by pumping. Reservoirs will not be constructed in wetlands unless the proper permits and clearances are obtained and may require mitigation.

Water Control Structures - Approximately 560 water control structures will be installed. These structures will improve water management and water quality by controlling runoff rate and trapping sediment. These structures will generally be included as part of the tailwater recovery system and will temporarily hold water until it can be pumped back into the reservoir.

Pumping Plants - Approximately 700 pumping plants will be installed. Pumping plants will consist of a pump and a power unit assembly which will be used to move water through the irrigation system, remove water from the delivery system, and fill reservoirs.

Wildlife and Waterfowl Considerations

The project area falls within the migratory route for many kinds of ducks and geese. The following measures are recommended to increase and improve wintering waterfowl habitat and thereby accomplishes the goals of the North American Waterfowl Management Plan.

Measures on private lands consist of:

- (1) Rolling stubble to allow ducks to settle into the fields and facilitate decomposition of rice straw;
- (2) Closing water control structures and repairing contour levees to hold rainfall through winter;
- (3) Flooding 45,000 acres of cropland annually for winter waterfowl use;
- (4) Passively managing 30,000 acres of crop fields annually for winter waterfowl use;
- (5) Leaving strips of unharvested crops (rice, soybeans, sorghum, wheat) in the field for wildlife and waterfowl use;
- (6) Promoting, cultivating, and maintaining buffer strips along riparian corridors;
- (7) Enhancing existing wetlands, farmed wetlands, wooded areas, and additional nonfarmed areas through water management;
- (8) Hunting three days or less a week, mornings only; (Heavy hunting pressure can drive ducks to other areas.)
- (9) Controlling beavers.



Photograph 3 - Flooded cropland attracts waterfowl during the winter.

The restoration and protection of wetlands under the Wetland Reserve Program (WRP) offers many benefits to the landowner. The WRP is a voluntary program offering landowners the opportunity to receive payments for restoring and protecting wetlands on their property. It is a means by which a landowner voluntarily sets limitations on the future use of the land, protecting its wetland values, and yet maintaining the land in private ownership.

Wetlands have great value because they improve water quality by filtering sediments and chemicals, reduce flooding of streams and rivers, recharge groundwater reserves, supply critical wildlife habitat, and furnish educational, scientific, recreational, and aesthetic benefits for people.

The zebra mussel (Dreissena polymorpha) appeared in Arkansas in 1992. It poses a multibillion dollar threat to North America's industrial, agricultural, and municipal water supplies, and could become a costly nuisance for freshwater shipping, boating, fishing and clamming.

This species of mussel is highly prolific and is a problem because it rapidly colonizes on any underwater surface. It forms masses up to 12 inches thick on underwater gates, boat hulls, and trash racks and is capable of clogging water intake structures, pipes, valves, screens, and plumbing in a very short period of time. Regular inspections for this mussel should be conducted to ensure that clogging does not occur.

Current status of the zebra mussel is that it is present at all locks and dams along the Arkansas River. It has not yet reached population densities which adversely affect operations. Thus no control measures in the District have begun.

The Arkansas Zebra Mussel Task Force was formed to deal with this problem. Team members consists of officials from the Little Rock District Army Corps of Engineers, the AG&FC, the AHTD, Arkansas State and Arkansas Tech Universities, and Entergy Corporation, a power producing firm.

Questions regarding the zebra mussel should be addressed to Gordon Bartelt, D or P .E., CESWL-EDHH, Little Rock District, Army Corps of Engineers, P.O. Box 867, Little Rock, AR 72203; FAX (501)324-5903.

Mitigation Features

No significant adverse environmental impacts were identified during the environmental evaluation; therefore, no mitigation features are required in the On-farm portion of the Recommended Plan.

Permits and Compliance

Section 404 of the Clean Water Act requires the sponsors to obtain a permit from the U.S. Army Corps of Engineers on natural resource projects. It is the responsibility of the landowner, conservation district, improvement district, city or other legal entity to obtain a permit before initiating work. The intent of the law is to protect waters from the discharge of dredged or fill material. After NRCS completes the final designs, the sponsors will use that information, in addition to the information in this document to apply for a permit. The sponsors will be required to show the proposed project is in compliance with EPA's 404(b)(1) guidelines.

Costs

The total costs of the on-farm portion of the project is estimated to be \$68,584,000 to install water conservation practices and provide technical assistance, including \$59,800,000 to install the practices and \$8,784,000 for technical assistance.

All technical assistance for the planning, layout, installation of the water conservation measures will be provided by NRCS.

The annual operation and maintenance costs are \$8,101,000 and are borne by the land owners.

Installation and Financing

This plan is prepared under the authority of the Corps of Engineers to provide protection to the groundwater base and irrigation water for the Grand Prairie area. Cost sharing will be provided by the Corps of Engineers.

The recommended plan will be installed under a 6 year installation period. An estimated 362 individual plans will be developed to install the on-farm aspects of the project.

Cultural Resources

If cultural resources are found during construction, construction will halt and the procedures of the NRCS general manual (420 GM 401) will be followed.

Operation, Maintenance, and Replacement

The responsibility and cost of operation, maintenance, and replacement (OM&R) for the delivery system rests with sponsoring local organizations. OM&R for on-farm practices installed as part of this project will be the responsibility of the individual landowners.

Operation includes the administration, management, and performance of nonmaintenance actions needed to keep a completed measure safe and functioning as planned. Maintenance and replacement includes performing work, applying measures, preventing deterioration of practices, and repairing damage or replacing of the measures if one or more of its components fail. This includes mowing or spraying weeds, repairing concrete, fertilizing, vegetating slopes, replacing riprap, removing sediment and debris from the channel, bridges, and corrugated metal pipes.

Damages to completed practices caused by normal deterioration, drought, and flooding caused by rainfall in excess of that for which measures were designed or vandalism are considered maintenance regardless of whether such damages occur immediately after or several years after a practice is installed or established.

The sponsor's responsibility for OM&R of a structural measure and the land users responsibility for OM&R of a practice begins when any segment or all of the installation is completed and accepted by the sponsors, land users, and NRCS.

LIST OF PREPARERS

The draft natural resource plan was reviewed and concurred in by state staff specialists having responsibility for engineering, soils, agronomy, range conservation, biology, forestry, administration, and geology.

TABLE 5

List of Preparers and Others Contributing Data

Name	Present Title / (Years in Job)	EDUCATION		EXPERIENCE	OTHER
		Degree(s)	Continuing Education Subjects	Titles/Years in Job	License, Papers, etc
NRCS WATER RESOURCES PLANNING STAFF					
Danny Goodwin	Watershed Specialist(1)	BS Psychol & Geography	Analysis of Watersheds & River Systems, High Hazard Dams, Hyd, Hydraulics, Dam Design, Landsat, Presenting Testimony, Mgmt, GW Mgmt, Agri Impacts on GW, GW Protection	Land Res Spec (1) Water Res Eng (7) WQ Specialist (7) Community Planner (2)	Papers Publications
Robert Price	Biologist (18)	BS Biology, Chemistry	Statistics, Soils Eng, Water Res Plng, Envrm Eng, Funds of Soil Science, Image Proc, Wetland Restoration Env Procedures in Project Planning, Landscape Architecture Environmental Design Landscape Design Landscape Const Design	Ecologist (4) Recreation Plnr (2) Reservoir Ranger (1) Biologist (1)	Papers Cert WL Biolog- ist
Tony Stevenson	Civil Eng (7)	BS Civ Eng	Construction Contr, Soil Mechanics, Econ, Irr Water Mgmt, Adv Anly of Irr Sys, Soils	Civil Engineer (5) Ag Eng (5)	Reg. Prof Eng
Alice Weeks	Civil Eng (7)	BS Ag Eng	Irrigation Water Mgmt Construction Contracts Soils Mechanics Wetland Restoration and Enhancement	Civil Engineer (7) Ag Engineer (5)	Reg. Prof Eng

Table 5 (continued)

List of Preparers and Others Contributing Data

Name	Present Title / (Years in Job)	EDUCATION		EXPERIENCE	OTHER
		Degree(s)	Continuing Education Subjects	Titles/Years in Job	License, Papers, etc
Eddie Bunch	Design Eng (2)	BS Ag Eng	Soil Mechanics Construction Contracts Hydrology Level III	Ag Engineer (5)	
Roy Crutchfield	Geologist (2)	BS Geology	Seepage Control for Dams, Geophysical Investigations, Geo Engineering, Tunneling Tech, Grouting Procedures	Geologist, COE (10) Geologist, USGS (2) Geologist, Bur of Rec (4) Geologist, Pet Exp (1)	Paper
Richard Fielder	Asst State Soil Scientist (2)	BS Agronomy	Mgmt, Soils, Soil Engineering, Soil Correlation	Soil Party Ldr (8) Soil Scientist (5) Soil Interp Spec (7)	Reg Soil Classif. (Ark)
Bob Fooks	Area Eng (15)	BS Ag Eng	Farm Irrigation Design Contract Administration Construction Inspection Irrigation Water Mgmt	Ag Eng (5)	Reg Prof Eng

TABLE 5 (continued)

List of Preparers and Others Contributing Data

Name	Present Title / (Years in Job)	EDUCATION		EXPERIENCE	OTHER
		Degree(s)	Continuing Education Subjects		
Andrew Hudson	Ag Econ (7)	BS Ag Adm MS Ag Econ PhD Ag Econ	Speaking, Writing, Mgmt, Statistics, Research Methods	Superv Ag Econ. (17) Ag Econ (4) Technical Asst (5) Asst Ag Econ (3) Asst Professor (1)	Papers
Randy Brown	Project Eng (8)	BS Ag Eng	Mgmt, Soil Mechanics, Contract Adm, Econ, Irr Water Mgt, Soils, Concrete, Hydrology	Ag Eng (9)	Reg PE
Mike Smith	Civil Eng (2)	BS Ag Eng	Fund. of Conc., Soil Eng. for Str. Meas. Soil Eng. in Cons. Oper. Water Qual.-Hydrogeology, Soils and Ag Nutr. Mgt., Const. Insp.	Ag Eng (3) Civ Eng (4)	
Jody Pagan	Biologist (1)	BS Biology, Chemistry		Biologist (2) Botanist (1)	LE & LT of AR Papers

TABLE 5 (continued)

List of Preparers and Others Contributing Data

OTHER AGENCIES REVIEWING OR PROVIDING INPUT

Arkansas Archaeological Survey (AAS)
Arkansas Department of Pollution Control and Ecology (ADPCE)
Arkansas Game and Fish Commission (AG&FC)
Arkansas Natural Heritage Commission (ANHC)
Arkansas Soil and Water Conservation Commission (ASWCC)
U. S. Corps of Engineers (USCE)
U. S. Fish & Wildlife Service (USFWS)
U. S. Forest Service (USFS)
Arkansas Geological Commission (AGC)
Arkansas Department of Health (ADH)
Arkansas Department of Parks and Tourism (ADPT)
Arkansas Waterways Commission (AWC)
Arkansas Natural and Scenic Rivers Commission (ANSRC)
Arkansas Historic Preservation Program (AHPP)
Arkansas Industrial Development Commission (AIDC)
Arkansas Forestry Commission (AFC)
Arkansas Highway and Transportation Department (AHTD)
Natural Resources Leasing Permit Program (NRLPP)
Federal Highway Administration (FHA)
Farm Service Agency (FSA)
Arkansas Office of Emergency Services (AOES)
U. S. Environmental Protection Agency (USEPA)

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Arkansas Historical Preservation Office

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TABLE 6

Effects of the Recommended Plan
on Resources of National Recognition

Types of Resources	Principal Sources of National Recognition	Measurement of Effects
Air quality	Clean Air Act, as amended (42 U.S.C. 7401 et seq.)	Minimal effect
Areas of particular concern within the coastal zone	Coastal Zone Management Act of 1972, as amended (16 U.S.C. 1451 et seq.)	Not present in planning area
Endangered and threatened species critical habitat	Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.)	None present in planning area
Fish & Wildlife Coordination	Act (16 U.S.C. Sec. 661 et seq.)	8849 acres of habitat water area gained
Floodplains	Executive Order 11988, Flood Plain Management	No effect
Historic & cultural properties	National Historic Preservation Act of 1966, as amended (16 U.S.C. Sec. 470 et seq.)	No effect
Prime & unique farmland	CEQ memorandum of August 1, 1980: Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing the National Environmental Policy Act, Farmland Protection Policy Act of 1981	8849 acres of prime farmland converted to reservoir
Water quality	Clean Water Act of 1977 (33 U.S.C. 1251 et seq.)	Temporary turbidity during construction
Wetlands	Executive Order 11990, Protection of Wetlands Clean Water Act of 1977 (33 U.S.C. 1251, et seq.)	No effect
Wild & Scenic Rivers	Food Security Act of 1985 Wild & Scenic Rivers Act, as amended (16 U.S.C. 1271 et seq.)	Not present in planning area

GRAND PRAIRIE AREA DEMONSTRATION PROJECT

NRCS ON-FARM REPORT

APPENDIX A

FACT SHEET

EASTERN ARKANSAS REGION COMPREHENSIVE STUDY GENERAL REEVALUATION - GRAND PRAIRIE AREA

PROJECT AREA	<u>EXISTING</u>				<u>PLANNED</u>			
	AR	PR	LO	MO				
	167,724	172,330	10,806	11,802	362,662 AC		362,662 AC	
TRACT FARMLAND					340,834 AC	94%	340,834 AC	94%
TRACT CROPLAND					254,406 AC	75%	245,557 AC	72%
RICE					87,833 AC	35%	87,833 AC	36%
LATE SOYBEANS (DOUBLE CROPPED W/WHEAT)					56,909 AC	22%	56,909 AC	23%
EARLY SOYBEANS					89,900 AC	35%	81,051 AC	33%
CORN					5,598 AC	2%	5,598 AC	2%
GRAIN SORGHAM					7,238 AC	3%	7,238 AC	3%
OTHER IRRIGATED ACRES					78 AC	0%	78 AC	0%
SUBTOTAL (IRRIGATED)					247,556 AC	97%	238,707 AC	97%
CRP					2,279 AC	1%	2,279 AC	1%
PASTURE AND HAYLAND					4,571 AC	2%	4,571 AC	2%
SUBTOTAL					6,850 AC	3%	6,850 AC	3%
EXISTING IRRIGATION RESERVOIRS					15,566 AC		15,566 AC	
PLANNED IRRIGATION RESERVOIRS (FROM CROPLAND)					0 AC		8,849 AC	4%
SUBTOTAL					15,566 AC		24,415 AC	
FISH AND WILDLIFE AREAS (WATER)					2,637 AC		2,637 AC	
FISH PONDS					3,070 AC		3,070 AC	
WATER USE (NORMAL YEAR)								
IN-SEASON DEMAND						498,024 AC-FT	2.09 FT	
OFF-SEASON DEMAND						154,052 AC-FT	0.65 FT	
PEAK MONTHLY DEMAND						171,097 AC-FT	0.72 FT	
STORAGE								
EXISTING						84,525 AC-FT	0.35	49%
PLANNED						88,493 AC-FT	0.37	51%
TOTAL						173,018 AC-FT	0.72	100%
WATER SOURCES								
STORAGE RESERVOIRS						152,055 AC-FT	0.64	31%
RUNOFF/TAIWATER						54,017 AC-FT	0.23	11%
GROUNDWATER						35,574 AC-FT	0.15	7%
IMPORT SYSTEM						256,381 AC-FT	1.07	51%
TOTAL						498,027 AC-FT	2.09	100%

OFF-SEASON WATER SOURCES

RUNOFF/TAIWATER	98,317 AC-FT	0.41	57%
IMPORT SYSTEM	74,701 AC-FT	0.31	43%
TOTAL	173,018 AC-FT	0.72	100%

IT SYSTEM

W/O LOSSES	W/ LOSSES
340 CFS	476 CFS
1,132 CFS	1,585 CFS

TOTAL TRACTS

1,578

	TRACTS W/DW	TFRMLND	TCRPLAND	
ARKANSAS CO.	548 AC	152,725 AC	119,706 AC	621 AC
LONOKE CO.	46 AC	11,425 AC	9,217 AC	58 AC
PRAIRIE CO.	714 AC	137,453 AC	105,159 AC	839 AC
MONROE CO.	55 AC	12,310 AC	9,612 AC	60 AC
TOTAL	1,363 AC	313,913 AC	243,694 AC	1,578 AC

TOTAL FARMS

867 AC

	FARMS W/DW	AVG FARMLAND	AVG CROPLAND
ARKANSAS CO.	375 AC	407 AC	319 AC
LONOKE CO.	32 AC	357 AC	288 AC
PRAIRIE CO.	430 AC	320 AC	245 AC
MONROE CO.	30 AC	410 AC	320 AC
TOTAL	867 AC	362 AC	281 AC

GRAND PRAIRIE AREA DEMONSTRATION PROJECT

NRCS ON-FARM REPORT

APPENDIX B

EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GENERAL REEVALUATION - GRAND PRAIRIE AREA

ALTERNATIVE EVALUATION

Apr-96

ALTERNATIVE NO. 1 - NO ACTION ALTERNATIVE (FUTURE WITHOUT PROJECT)

ASSUMPTIONS:

1. THE CONVERSION PERIOD IS ESTIMATED TO BE APPROXIMATELY 30 YEARS.
2. STORAGE RESERVOIRS WILL BE CONSTRUCTED LINEARLY DURING THE CONVERSION PERIOD.
3. IRRIGATION EFFICIENCIES WILL INCREASE LINEARLY FROM 60% TO 70% DURING THE CONVERSION PERIOD.
4. GROUNDWATER WITHDRAWAL WILL DECLINE LINEARLY TO SAFE YIELD LEVELS DURING THE CONVERSION PERIOD.
5. GROUNDWATER WITHDRAWALS WILL BE REGULATED TO SAFE YIELD LEVELS IN APPROXIMATELY 3
6. RICE ACREAGE WILL BE MAXIMIZED.
7. THE SPARTA SAND AQUIFER WILL NOT BE UTILIZED AS A PRIMARY IRRIGATION SOURCE.

OFF-SEASON SUPPLY

98,317 AC-FT	POTENTIAL STORAGE (OFF-SEASON RUNOFF/TAIWATER)
84,525 AC-FT	EXISTING STORAGE

13,792 AC-FT	POTENTIAL NEW STORAGE
10 FT	ESTIMATED DEPTH OF NEW STORAGE

1,379 AC	IRRIGATED CROPLAND CONVERTED TO STORAGE

IN-SEASON SUPPLY

98,317 AC-FT	STORAGE RESERVOIRS
54,017 AC-FT	RUNOFF/TAIWATER
35,574 AC-FT	GROUNDWATER @ SAFE YIELD

187,908 AC-FT	TOTAL IN-SEASON SUPPLY
2.63 AC-FT/AC	NET IRR. REQUIREMENT (RICE 22.05 IN. @ 70% EFF. = 31.5 IN. = 2.625 FT.)

71,584 AC	MAX. RICE ACREAGE

ESTIMATED LAND USE CHANGE

247,556 AC	EXISTING IRRIGATED CROPLAND
1,379 AC	IRRIGATED CROPLAND CONVERTED TO STORAGE
71,584 AC	MAX. RICE ACREAGE

174,593 AC	IRRIGATED CROPLAND CONVERTED TO DRYLAND FARMING

EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GENERAL REEVALUATION - GRAND PRAIRIE AREA

ALTERNATIVE EVALUATION
Apr-96

ALTERNATIVE NO. 2 - CONSERVATION/STORAGE ALTERNATIVE

ASSUMPTIONS:

1. THE INSTALLATION PERIOD IS ESTIMATED TO BE APPROXIMATELY 5 YEARS.
2. STORAGE RESERVOIRS WILL BE CONSTRUCTED LINEARLY DURING THE INSTALLATION PERIOD.
3. IRRIGATION EFFICIENCIES WILL INCREASE LINEARLY FROM 60% TO 70% DURING THE INSTALLATION PERIOD.
4. DEPLETION OF GROUNDWATER RESERVES WILL BE DELAYED APPROXIMATELY 25 YEARS LONGER THAN WITHOUT PROJECT CONDITIONS.
5. GROUNDWATER WITHDRAWAL WILL DECLINE LINEARLY DURING A 50 YEAR PERIOD.
6. GROUNDWATER WITHDRAWALS WILL BE REGULATED TO SAFE YIELD LEVELS IN THE YEAR 2055.

OFF-SEASON SUPPLY

98,317 AC-FT	POTENTIAL STORAGE (OFF-SEASON RUNOFF/TAILWATER)
84,525 AC-FT	EXISTING STORAGE

13,792 AC-FT	POTENTIAL NEW STORAGE
10 FT	ESTIMATED DEPTH OF NEW STORAGE

1,379 AC	IRRIGATED CROPLAND CONVERTED TO STORAGE

IN-SEASON SUPPLY

98,317 AC-FT	STORAGE RESERVOIRS
54,017 AC-FT	RUNOFF/TAILWATER
35,574 AC-FT	GROUNDWATER @ SAFE YIELD

187,908 AC-FT	TOTAL IN-SEASON SUPPLY
2.63 AC-FT/AC	NET IRR. REQUIREMENT (RICE 22.05 @ 70% EFF. = 31.5 IN. = 2.625 FT.)

71,584 AC	MAX. RICE ACREAGE

ESTIMATED LAND USE CHANGE

247,556 AC	EXISTING IRRIGATED CROPLAND
1,379 AC	IRRIGATED CROPLAND CONVERTED TO STORAGE
71,584 AC	MAX. RICE ACREAGE

174,593 AC	IRRIGATED CROPLAND CONVERTED TO DRYLAND FARMING

EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GENERAL REEVALUATION - GRAND PRAIRIE AREA

ALTERNATIVE EVALUATION

Apr-96

ALTERNATIVE NO. 3 - CONSERVATION/STORAGE/ALTERNATE SOURCE ALTERNATIVE
(RECOMMENDED PLAN)

ASSUMPTIONS:

1. THE INSTALLATION PERIOD IS ESTIMATED TO BE APPROXIMATELY 13 YEARS.
2. STORAGE RESERVOIRS WILL BE CONSTRUCTED LINEARLY DURING THE INSTALLATION PERIOD.
3. IRRIGATION EFFICIENCIES WILL INCREASE LINEARLY FROM 60% TO 70% DURING THE INSTALLATION PERIOD.
4. GROUNDWATER WITHDRAWAL WILL DECLINE LINEARLY TO SAFE YIELD LEVELS DURING THE ESTIMATED INSTALLATION PERIOD.

OFF-SEASON SUPPLY

74,701 AC-FT	IMPORT
98,317 AC-FT	RUNOFF/TAILWATER

173,018 AC-FT	TOTAL PLANNED STORAGE
84,525 AC-FT	EXISTING STORAGE

88,493 AC-FT	POTENTIAL NEW STORAGE
10 FT	ESTIMATED DEPTH OF NEW STORAGE

8,849 AC	IRRIGATED CROPLAND CONVERTED TO STORAGE

IN-SEASON SUPPLY

256,381 AC-FT	IMPORT
152,055 AC-FT	STORAGE RESERVOIRS (AVAILABLE FOR IRRIGATION)
54,017 AC-FT	RUNOFF/TAILWATER
35,574 AC-FT	GROUNDWATER @ SAFE YIELD

498,027 AC-FT	TOTAL IN-SEASON SUPPLY
2.08 AC-FT/AC	NET IRR. REQUIREMENT (2.0826145 AC-FT/AC)

239,091 AC	MAX. CROPLAND ACREAGE SUPPORTED

ESTIMATED LAND USE CHANGE

247,556 AC	EXISTING IRRIGATED CROPLAND
8,849 AC	IRRIGATED CROPLAND CONVERTED TO STORAGE

238,707 AC	MAX. CROPLAND AVAILABLE
239,091 AC	MAX. CROPLAND ACREAGE SUPPORTED

-385	IRRIGATED CROPLAND CONVERTED TO DRYLAND FARMING

GRAND PRAIRIE AREA DEMONSTRATION PROJECT

NRCS ON-FARM REPORT

APPENDIX C

Irrigation Water Management Plan
for

J.T. Farmer
Anywhere, Arkansas

Irrigation water management is the act of timing and regulating irrigation water application in way that will satisfy the water requirement of the crop without wasting water, soil, and plant nutrients and degrading the soil resource. This involves applying water:

According to crop needs.

In amounts that can be held in the soil and be available to crops.

At rates consistent with the intake characteristics of the soil and the erosion hazard of the site.

So that water quality is maintained or improved.

Such that fish and wild habitat may be improved due to the ability to control water.

The net results of proper irrigation water management typically:

Prevent excessive water use of water for irrigation purposes.

Prevent excessive soil erosion.

Reduce labor.

Minimize pumping costs.

Maintain or improve the quality and quantity of groundwater and surface water.

Increase crop biomass yield and product quality.

This Water Management plan has been developed with your input into the planning, design, and operation of your system. The Natural Resources Conservation Service will provide additional technical assistance upon request should your operations change or if problems occur.

The following actions are recommended as part of this Water Management Plan:

1. Install conservation practices according to the plans and specifications developed by NRCS. Conservation practices are designed to provide fish and wildlife benefits when feasible.
2. Install flow meters on all pumping plants.
3. Select an irrigation scheduling method to determine when to irrigate and how much to apply. NRCS can provide assistance with alternatives.
4. January - April -- Fill reservoirs with natural runoff utilizing tailwater recovery system. Utilize field levees from previous farming season to control runoff and to increase the amount of water available to fill reservoirs.
5. May - September -- Utilize irrigation scheduling to determine when to irrigate and how much to apply. Priority for use of available sources should be:
 - A. Runoff/tailwater - This is generally the most economical source of water and should be utilized to irrigate crops and/or replenish reservoirs when available.
 - B. Import water - This source should be utilized as much as possible to irrigate crops and/or replenish reservoirs when available. Withdrawal may be limited or eliminated during periods of low river flow.
 - C. Reservoir - This source should be utilized to supplement the sources above in order to provide adequate flow to the crops. Reservoirs should be managed to provide fish and wildlife benefits when feasible.
 - D. Groundwater - This source should be utilized to supplement the sources above in order to provide adequate flow to crops during crisis periods and should be considered for emergency use only.
6. October -- Perform maintenance on structural and mechanical features of the water management system.
7. November - December -- Close field levees in order to store rainfall for waterfowl use and to hold water for filling reservoirs in the spring. Utilize reservoir or import water to partially flood fields for waterfowl use. Manage reservoirs for fish by maintaining minimum depths recommended by fishery biologists or manage for waterfowl and shorebirds by partially exposing sloped bottom.

Typical Farm Water Management Plan
Grand Prairie Area

Existing:

Farm size: 375 ac
Woodland: 75 ac
Cropland: 300 ac (irrigated)
Rice: 100 ac
Early beans: 100 ac
Late beans: 100 ac (double cropped w/ wheat)

Irrigation system:

Wells: 2 (1500 gpm/well)
Relifts: None
Pipelines: 2 (12"-1320'/line)
Storage: None
Efficiency: 60%

Planned:

Farm size: 375 ac
Woodland: 75 ac
Reservoir: 20 ac
Cropland: 280 ac (irrigated)
Rice: 100 ac
Early beans: 80 ac
Late beans: 100 ac (double cropped w/ wheat)

Water Budget Results

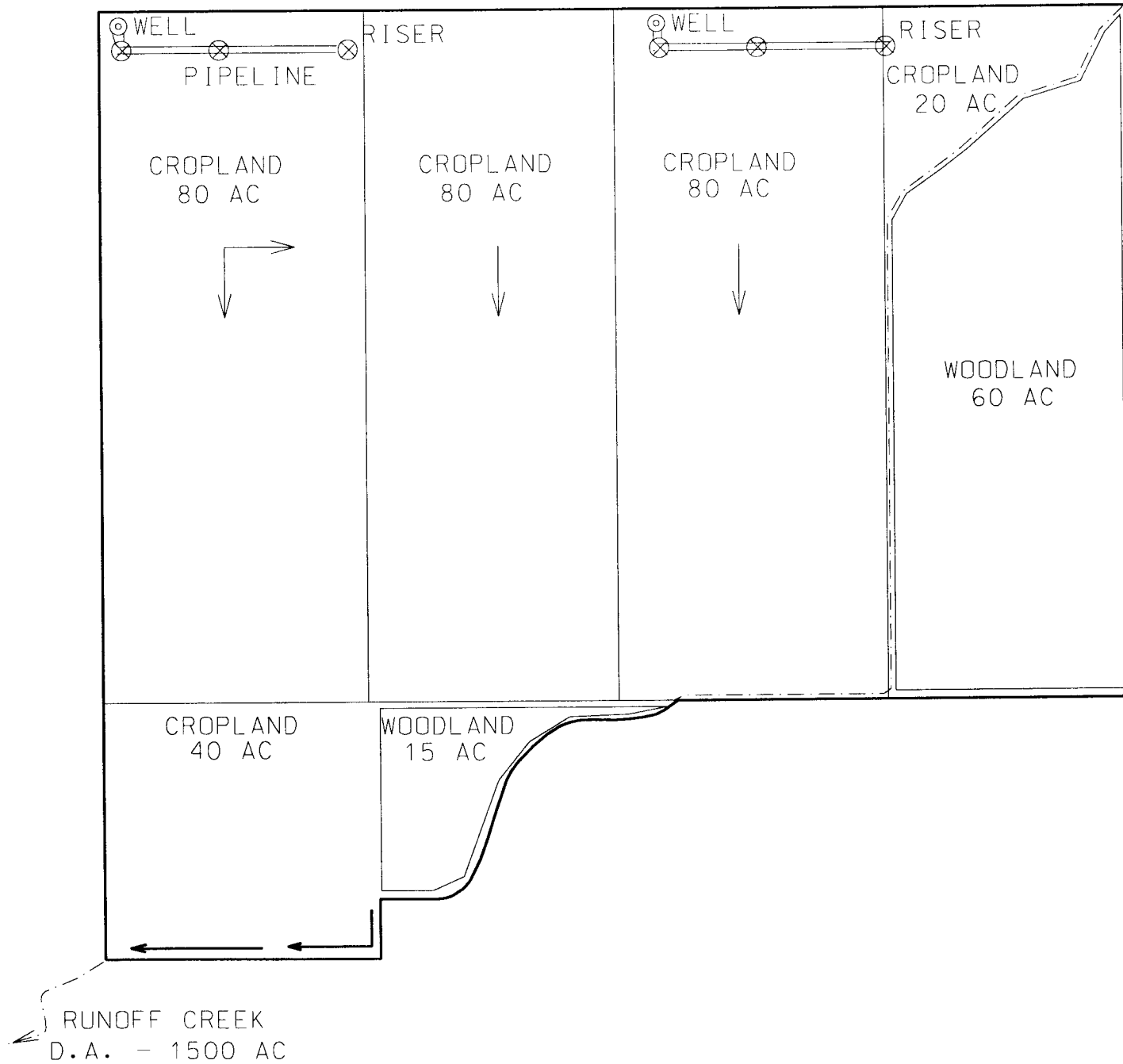
In-season demand	560 ac-ft
In-season sources	560 ac-ft
Storage	148 ac-ft
Tailwater/runoff	65 ac-ft
Groundwater	1 ac-ft
Import	346 ac-ft

Off-season demand	157 ac-ft
Off-season sources	157 ac-ft
Tailwater/runoff	97 ac-ft
Import	60 ac-ft

Irrigation system:

Wells: 2 (1500 gpm/well) (Emergency use only)
Relifts: 1 (2800 gpm)
Pipelines: 2 (12"-1320'/line) (existing)
1 (15"-3200')
1 (15"-1320')
Storage: 1 Reservoir (160 ac-ft, 20 ac)
Efficiency: 70%

TYPICAL FARM
(EXISTING IRRIGATION SYSTEM)



FARM PLAN NAME:	J. T. FARMER	FARM NO:	1000 SYSTEM NO:	1000
GROUP NO: A	QUAD: ONE HORSE STORE	DEL. NO:	1800 SEG. NO:	1

Tract Number	Farmland Acres	Cropland Acres	Rice Acres	Pln Strg Ac-Ft	Demand Q GPM	Delv Q GPM	Rice Q GPM	Irr Crplnd Acres
100300	375	280	100	148	1,389	801	1,390	280
					0	0	0	
					0	0	0	
					0	0	0	
					0	0	0	
					0	0	0	
TOTALS	375	280	100	148	1,389	801	1,390	280

PLANNED STORAGE

RES NO	ACRES	DEPTH(FT)	LEVEE(FT)	VOL(AC-FT)	LEVEE(CY)	UNIT COST	TOTL COST	COST/AC
1	20	8.0	4,000	160	52,148	\$0.85	\$44,326	
				0	0	\$0.85	\$0	
				0	0	\$0.85	\$0	
TOTALS	20			160	52,148		\$44,326	\$158

PLANNED PIPELINES

PIPLN NO	DIAM(INS)	LENGTH(FT)	MAX GPM	UNIT COST	TOTL COST	COST/AC
1	15	3,200	2,800	\$6.00	\$19,200	
2	15	1,300	2,800	\$6.00	\$7,800	

TOTALS	\$27,000	\$96
---------------	-----------------	-------------

PLANNED TAILWATER RECOVERY SYSTEMS

TWR NC	LENGTH(FT)	CY/FT	VOL(CY)	UNIT COST	TOTL COST	COST/AC
1	1,300	0.74	962	\$0.85	\$818	
2	3,600	0.74	2,664	\$0.85	\$2,264	

TOTALS	\$3,082	\$11
---------------	----------------	-------------

PLANNED PUMPING PLANTS (ELECTRIC - TYPE1, DIESEL - TYPE 2) (RELIFTS ONLY)

PP NO	TYPE	PIPE DIA (IN)	Q MAX(GPM)	TOTL COST	COST/AC
1	1	15	2,800	\$13,500	

TOTALS	\$13,500	\$48
---------------	-----------------	-------------

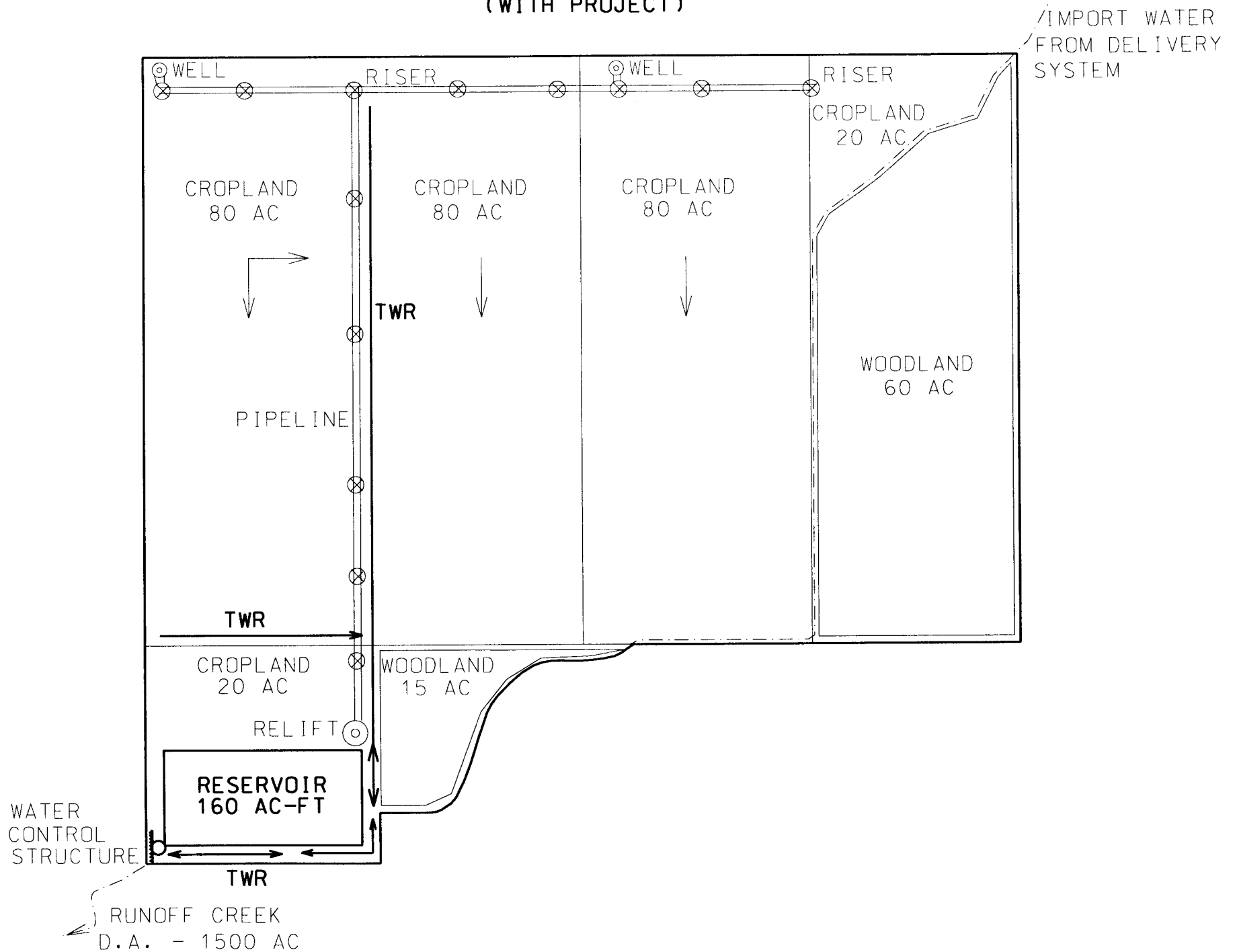
PLANNED WATER CONTROL STRUCTURES

WCS NO	DRG AREA(AC)	DRG Q(CFS)	PIPE SZ(IN)	TOTL COST	COST/AC
1	1,500	92	72	\$16,000	

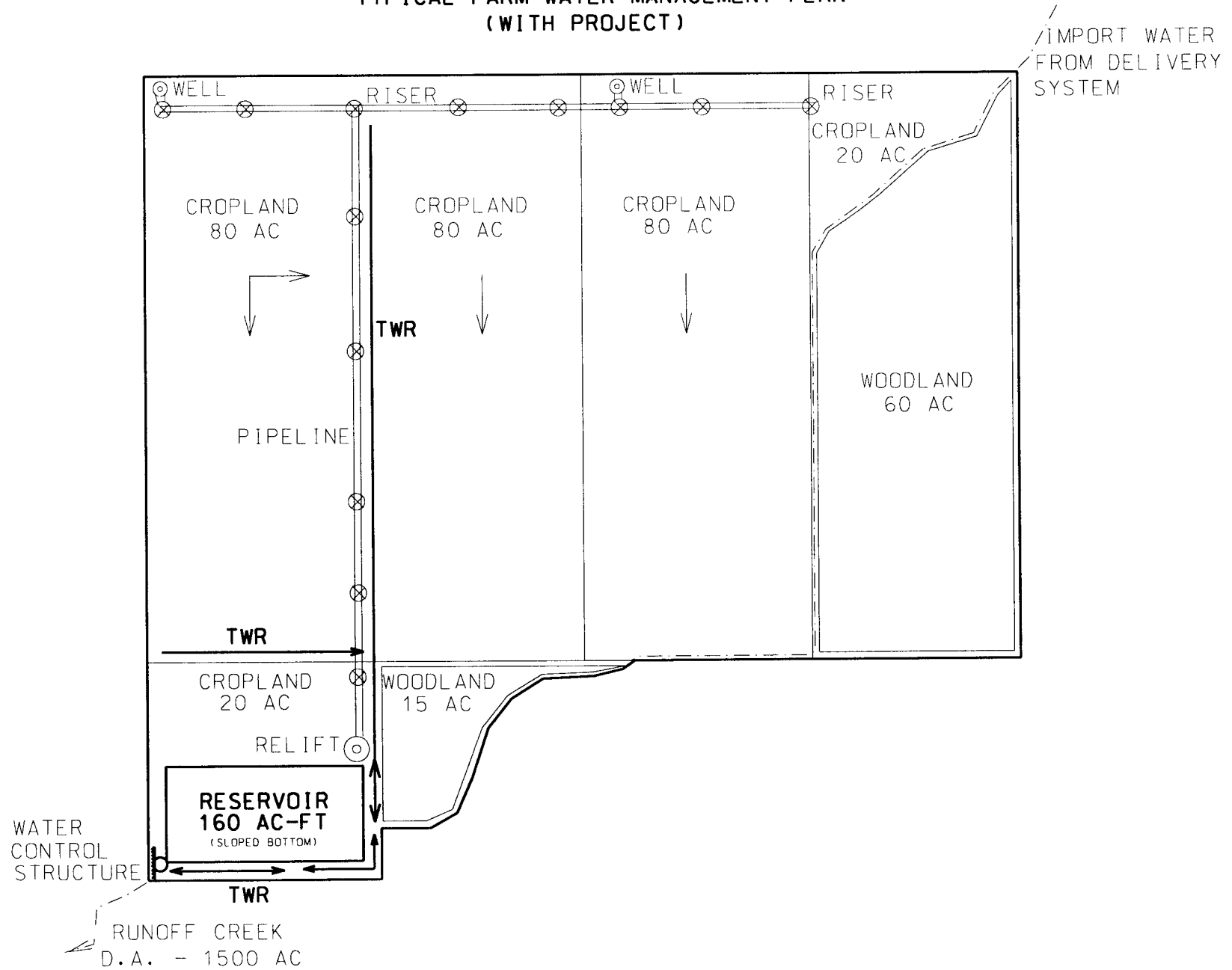
TOTALS	\$16,000	\$57
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GRAND TOTALS	COST/AC=	\$371	TOTAL COST \$103,908
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TYPICAL FARM WATER MANAGEMENT PLAN
(WITH PROJECT)



**TYPICAL FARM WATER MANAGEMENT PLAN
(WITH PROJECT)**



GRAND PRAIRIE AREA DEMONSTRATION PROJECT

SECTION II

DOCUMENTATION REPORT

GRAND PRAIRIE AREA DEMONSTRATION PROJECT

NRCS ON-FARM REPORT

**APPENDIX D
(SECTION II)**

EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GENERAL REEVALUATION (GRAND PRAIRIE AREA)

DOCUMENTATION REPORT

PREPARED BY:

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

March 1997

EASTERN ARKANSAS REGION COMPREHENSIVE STUDY
GENERAL REEVALUATION (GRAND PRAIRIE AREA)
DOCUMENTATION REPORT

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SECTION A

INTRODUCTION

This report was prepared as a part of the Eastern Arkansas Region Comprehensive Study General Reevaluation (Grand Prairie Area) which is being conducted by the United States Army Corps of Engineers (Memphis District). The study details a plan to protect the groundwater resource of the area while supplying water for irrigation, fish farming, and the enhancement of fish and wildlife habitat. The Corps of Engineers has entered into a cooperative agreement with the United States Department of Agriculture, Natural Resources Conservation Service (formerly the Soil Conservation Service) to assist in the planning and development of the project.

SECTION B

PURPOSE

The purpose of this report is to document the work conducted by the Natural Resources Conservation Service during fiscal years 1992 through 1997 on the Eastern Arkansas Region Comprehensive Study General Reevaluation - Grand Prairie Area. This report is intended to be an appendix to the NATURAL RESOURCE PLAN for the ON-FARM PORTION of the EASTERN ARKANSAS REGION COMPREHENSIVE STUDY GENERAL REEVALUATION - GRAND PRAIRIE AREA, prepared by the Natural Resources Conservation Service, March 1997.

It should be noted that on October 13, 1994, President Bill Clinton signed legislation which formally changed the name of the Soil Conservation Service (SCS) to the Natural Resources Conservation Service (NRCS).

The data sources, assumptions, and methodology of the work conducted by the Soil Conservation Service prior to this date remain valid unless otherwise noted in this report.

SECTION C

WORK AUTHORIZATION

The work performed by the Natural Resources Conservation Service was authorized by a letter and a document entitled "Addendum No. 1, Scope of Work, Eastern Arkansas Region Comprehensive Study, Grand Prairie Area - General Reevaluation", dated December 10, 1992. This addendum referred to the "Plan of Work for the Soil Conservation Service Participation, Supplement No. 1, as revised November 25, 1992" which outlined specific tasks to be completed, estimated time and personnel to perform the tasks, and the estimated costs to complete the work. The agreement was

finalized in a letter of approval from Ronnie Murphy, Arkansas State Conservationist, Soil Conservation Service to Colonel Clinton W. Willer, District Engineer, Memphis District Corps of Engineers.

A copy of these documents are included in Appendix A.

SECTION D

GENERAL DESCRIPTION OF THE PROJECT

The proposed project area includes portions of Arkansas, Prairie, Lonoke, and Monroe Counties in eastern Arkansas. This project covers approximately 360,000 acres which includes approximately 250,000 acres of cropland. This area is a major rice and soybean producing area which relies heavily on groundwater as an irrigation source. The extensive use of the groundwater resource has depleted groundwater reserves to extremely low levels and continued use at current rates threatens to severely damage the resource. The Eastern Arkansas Water Conservation Project (EAWCP), the Arkansas State Water Plan, and several United States Geological Survey (USGS) studies have reported average annual water level declines of 0.5 to 0.7 feet per year. The aquifer is generally less than 100 feet in saturated thickness with some critical areas at less than 20 feet of saturated thickness.

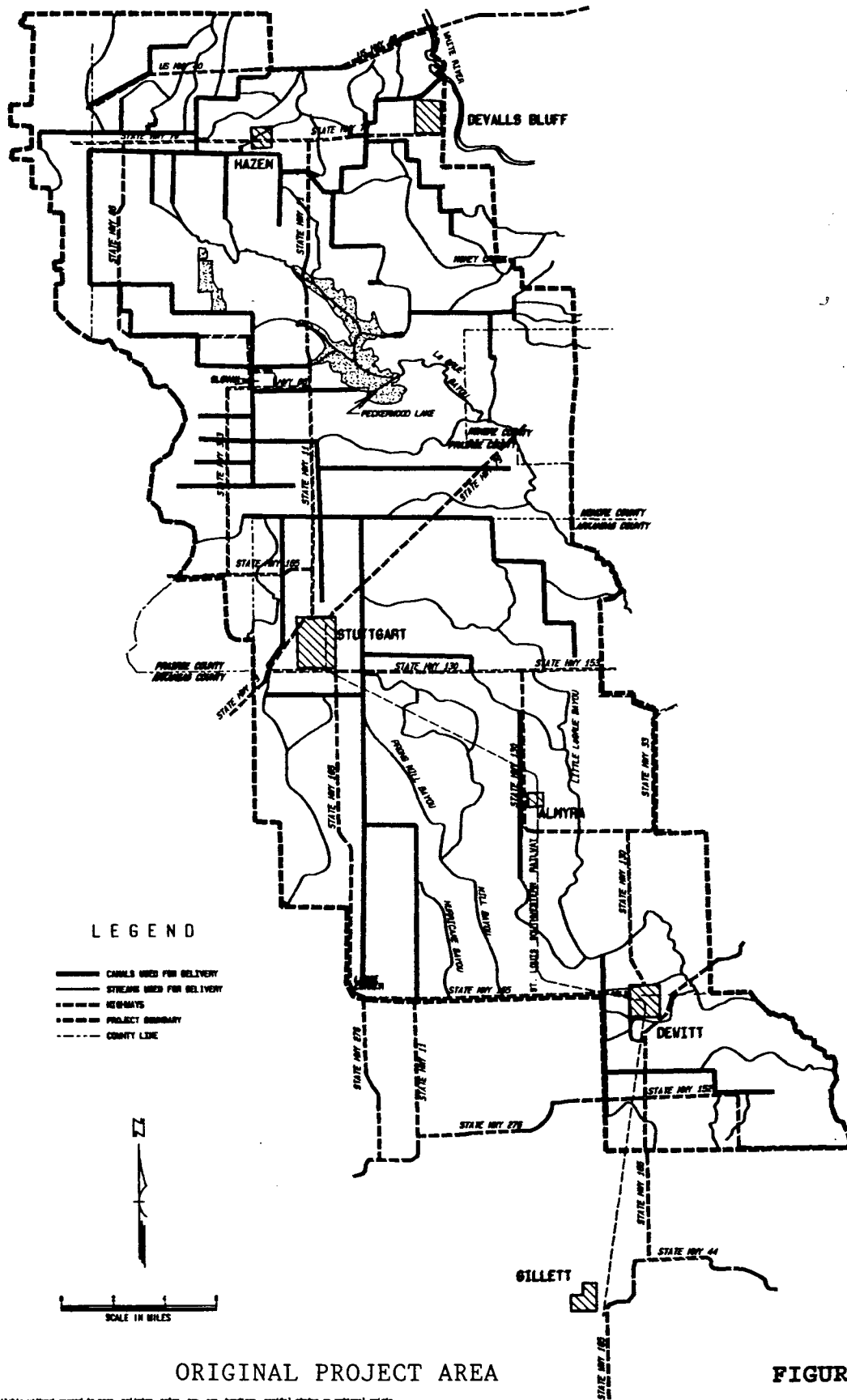
The proposed project would preserve the groundwater resource while providing a sustained agricultural water supply to the project area such that the region's farm based economy can continue to function.

The East Arkansas Region Comprehensive Study (EARCS) and the Eastern Arkansas Water Conservation Project (EAWCP) have indicated that the objectives of the project can be accomplished by implementing a combination of measures such as: improved irrigation efficiencies, additional on-farm water storage reservoirs, the diversion of excess surface runoff from the White River, and utilizing the groundwater resource at safe yield levels.

Irrigation efficiencies can be improved by installing water conservation practices such as reservoirs, tailwater recovery systems and underground irrigation pipelines, and implementing irrigation water management practices such as soil moisture monitoring and irrigation scheduling.

On-farm storage now supplies approximately 14% of the irrigation water and can be increased by constructing additional storage reservoirs on individual properties. Reservoirs store excess runoff and improve management of the on-farm irrigation system.

The diversion of excess surface runoff from the White River can be accomplished by the installation of a large diversion pumping



ORIGINAL PROJECT AREA

FIGURE 1

Assurances to available without regard to race, religion, color, sex, age, handicap, marital status or national origin.

EASTERN ARKANSAS REGION COMPREHENSIVE STUDY GRAND PRAIRIE IRRIGATION PROJECT PLAN 1 U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	Designed _____ Drawn _____ Traced _____ Checked _____	Approved _____ Date _____ Title _____ Date _____
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plant on the White River north of DeValls Bluff. This pumping plant would discharge into a system of canals, streams, and pipelines in order to deliver water throughout the project area.

Groundwater resources are planned to be utilized at the sustained safe yield level.

SECTION E

SCOPE OF WORK

This section of the documentation report describes the items of work scheduled for completion by the Natural Resources Conservation Service as outlined in the interagency agreement "Scope of Work for Fiscal Year 1992" and the "Plan of Work for the Soil Conservation Service Participation, Supplement No. 1" (See Appendix A).

All data included in this report is part of the data base information which was included on computer disks located in the pocket of Appendix B of the original document submitted to the Corps of Engineers. Additional copies of the data base disks are available upon request from:

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STATE CONSERVATION ENGINEER
Room 5404, Federal Building
Little Rock, Arkansas 72201

SECTION F

PROJECT ASSUMPTIONS

In order to provide reasonable and consistent estimates of water requirements within the project area, it was necessary to make several initial assumptions. These assumptions are not intended to indicate the farming operation of individual tracts or the operation of individual irrigation systems. The farming operations and the operation of individual irrigation systems will be left strictly to the farmers. Certain restrictions will be placed on the removal of water from the project delivery system network.

Based on the EAWCP, the EARCS, and field reconnaissance of the project area, the SCS project planning team has assumed that:

1. All cultivated cropland is irrigated.
2. All pumping plants, including individual wells and relifts, will be operated a maximum of 20 hours during a 24 hour day. This allows for system

interruptions due to water availability, breakdown and for routine maintenance.

3. All on-farm storage reservoirs will be filled beginning January 1 and filling will be completed by April 30.
4. Land use data as reported to ASCS is the most reliable source of information and will be utilized when available.
5. Peak import flow rates (Q's) for the delivery system will occur during the irrigation season.
6. Runoff captured by tailwater recovery systems will be used to supply water demand and fill reservoirs.
7. The White River has adequate flow to supply the import water need based on a 20 hr/day period.

Note: Detailed analysis of White River flow by the Corps of Engineers disproved this assumption. On-farm storage reservoirs can provide adequate supplies during low flow periods.

8. All landowners and operators with cultivated land in the project area will use imported surface water from the delivery system.
9. The irrigation efficiency will be constant throughout the project area.
10. Commercial fish farming operations will utilize imported surface water.
11. Evaporation in excess of rainfall in all lakes and reservoirs, including fish ponds, is considered a demand.
12. Twenty five percent of the fish pond volume will be drained annually and refilling will occur during April.
13. Flooding land for winter waterfowl will occur during October and November.

Note: This was later revised to November and December.

14. The Run SMA 2030 Peralta ground water data is used to indicate the safe yield from the ground water resource.
15. Groundwater availability is divided equally within the Peralta cell.

16. Groundwater withdrawal on a individual tract was based on the irrigated cropland.
17. Planting and harvesting dates of crops are constant throughout the project area.
18. Soil irrigation characteristics are constant throughout the project area.
19. Wheat and oats are not irrigated.
20. All wheat and oats are double cropped with late soybeans which are irrigated.
21. Existing reservoir volumes will be computed by measuring surface areas and estimating depths.
22. All existing reservoirs will be utilized throughout the life of the project.
23. Water will be made available to all tracts with cultivated cropland.
24. Farm base acreages will be allocated proportionally to the tract cropland acres.
25. ASCS reported cropland acreages for 1991 will be used as the project cropland acres.
26. Cropland in excess of ASCS base acres CRP or grass is considered to be planted with early soybeans.
27. New reservoirs will be constructed on soybean acreage when available. Additional area required will be taken from rice acreage.
28. All other land use will remain constant throughout the life of the project.
29. Peak flow rates computed in this phase of the project are for tract requirements only. Minimum stream flow requirements for seepage and evaporation losses, fish and wildlife needs, water quality, and storm capacities will be added to the computed flow rates during the hydraulic analysis.
30. The project boundaries will be within the White River Regional Irrigation Water Distribution District. The initial proposed boundaries will be determined by water needs and tract location.
31. Any tract adjacent to a segment of the delivery system is considered to be provided with a water source.

32. All tracts will be capable of capturing tailwater and runoff from the irrigated acres.
33. Water will be used according to the following priorities:
 - 1) runoff capture
 - 2) import water
 - 3) storage
 - 4) groundwater
34. Approximately 25% of the irrigation water requirements will be supplied from new or existing storage reservoirs.

SECTION G

DATA COLLECTION

LAND USE DATA

Land use data was obtained from ASCS records, aerial photographs, USGS quadrangle maps, and field inspection. Farmers participating in the USDA Farm Programs report annual cropping history to the ASCS. The cropping history is used to calculate crop "base" acreages on which farm subsidy payments are made.

ASCS has developed a tracking system for reporting cropping history which consists of a farm number and a tract number. The tract is the smallest designation on which ASCS records are maintained and is a contiguous piece of property with single or group ownership. A farm may consist of a single tract or a group of tracts. Base acreage are computed on a farm basis.

Tract boundaries are outlined on ASCS aerial photographs with the assistance of landowners and farmers. Each tract in a county is assigned a unique number by ASCS personnel. This parcel of ground retains this tract designation permanently unless the tract is split due to the transfer of ownership. If a tract is split, the parts are assigned new unique numbers and the boundaries are outlined on the aerial photographs. Old tract numbers are not reused. Parcels of land not in the ASCS Farm Programs were assigned tract numbers beginning at 5000 by NRCS personnel.

NRCS personnel worked closely with ASCS personnel to obtain the necessary records for tracts located within the proposed project boundary. Land use information was not available from ASCS on property not enrolled in the USDA Farm Programs. Land use for these parcels was obtained from aerial photographs, USGS quadrangle maps, field observation, and NRCS records.

The SCS study team developed a six digit tract numbering system which is consistent with the ASCS tract numbering system with a few modifications. The ASCS tract number consists of a maximum of four digits. An example tract number is 1032 in Arkansas county. Since the project area covers parts of four counties it was necessary to add a one digit county identifier to the front of the tract number. The county identifier numbers are: Arkansas county - 1, Lonoke county - 2, Prairie county - 3, and Monroe county - 4. In addition, because some tracts are very large land areas and require division in order to adequately deliver water to the tract, a one digit division identifier was added to the end of the ASCS tract number. A zero division identifier indicates the tract was not split. Any other digit indicates the tract was split and each part was assigned a division identifier from one through nine. Thus, if tract number 1032 in Arkansas county was not split the project tract number would become 110320. If the tract was split into two sections the project tract numbers would be 110321 and 110322. Figure 2 shows a graphic explanation of the project tract number.

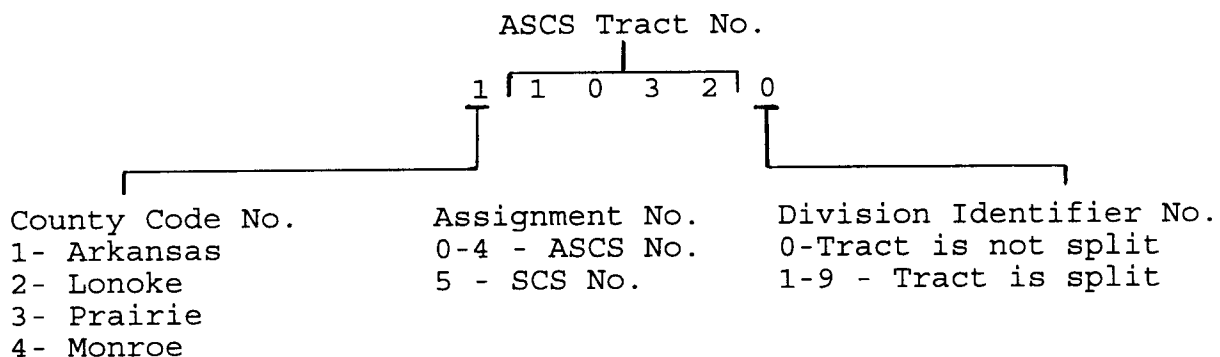


FIGURE 4

The tract boundaries and the four digit ASCS tract numbers were manually transferred from the ASCS aerial photos to the Corps of Engineers aerial photos. The Corps of Engineers utilized these photos to digitize the tract boundaries into a Geographic Information System (GIS) which was utilized in the planning the design of the project. The tract boundaries and numbers were also transferred to USGS quadrangle maps which were utilized in the planning and layout of the delivery system network. Land use data is included in the data base file with categories listed and defined in Appendix G.

EXISTING STORAGE DATA

Existing water bodies were identified from a visual survey of the Corps of Engineers aerial photographs and surface areas were computed by the use of a planimeter. The average depth and current use of each water body was determined by SCS personnel

using SCS records, personal knowledge, and landowner or farmer interviews. Existing storage data is included in the data base file with categories listed and defined in Appendix G.

CLIMATIC DATA

Climatic data was obtained from the National Oceanic and Atmospheric Administration (NOAA) and the Corps of Engineers for the Stuttgart reporting station for the period of record 1965 through 1981. A copy of the raw data is included in Appendix D.

SOIL DATA

A review of the General Soil Map indicated that the primary soil type for the project area is the Crowley-Stuttgart-Grenada Association which consists of poorly drained to moderately well drained, level to gently sloping, loamy soils that formed in windblown silts overlying old alluvium on upland flats and low ridges. These soils exhibit similar farming and irrigation characteristics which include texture, available water capacity, and the existence of a compact subsoil. Due to the similarities of the soils located in the project area no distinctions of soil type were made for planning purposes.

PLANTING AND HARVEST DATES

Typical planting and harvest dates for the primary crops grown in the project area were provided by the Natural Resources Conservation Service state agronomist. This data was utilized in the water budget and consumptive use computations. A copy of his report is included in Appendix F.

SECTION H

DELIVERY SYSTEM NETWORK

The delivery system for the project will consist of canals, streams and pipelines. Water from the White River will be pumped into a canal which begins near DeValls Bluff and extends west to near Carlisle and then south to Lodge Corner. Water will be released or pumped into other canals, streams, and pipelines along the entire length of the primary canal. Gravity flow will be used whenever possible to deliver water. Water will be controlled by a system of weirs and gates throughout the delivery system network.

The SCS planning team used preliminary studies, aerial photography, USGS quadrangle maps, and field observations to plan the layout of the delivery network. The delivery system was planned to supply water to all tracts with irrigated land within

the project area. It would be anticipated that additional analysis would result in some alignment changes, but would not result in significant impacts to the project.

The planning team developed a seven digit delivery system numbering system which aids in the location of individual components and allows automated analysis of the system.

The numbering system consists of four digits to the left of the decimal point and three digits to the right of the decimal point. Trailing zeros to the right of the decimal point are dropped to save time and space. Four digit numbers indicate that this segment of the delivery system is a canal or stream while six or seven digit numbers indicate that this segment is a pipeline. Lateral canals or streams will be referred to as channels as there is no distinction in the numbering system, however, they are identified in Appendix H.

The primary canal is divided into six sections designated by even 1000 series numbers beginning with 1000 at the pumping plant and continuing through 6000 near Lodge Corner. (See Figure 5)

The first lateral channel downstream from the pumping plant along canal 1000 is numbered 1100. The second lateral channel along canal 1000 is numbered 1200. The sequence continues until approximately five lateral channels have been designated. At this point the primary delivery canal is assigned number 2000. The same sequence continues as the first lateral channel downstream along canal 2000 is numbered 2100.

In similar fashion, the first lateral channel downstream along canal 2100 is numbered 2110 and the first channel along canal 2110 is numbered 2111. Each subdivision is limited to nine laterals due to the limitations of the numbering system.

All pipelines are designated by a six or seven digit number. The four digits to the left of the decimal point indicate the source channel and the digits to the right of the decimal point indicate the location along the channel. In order to account for many pipelines along a channel, the first two digits to the right of the decimal point are utilized to indicate its location along the channel. Thus, the first pipeline downstream along channel 2111 is numbered 2111.01. The third digit to the right of the decimal point is reserved for lateral pipelines along the main pipeline. Pipeline 2111.011 is the first lateral pipeline along pipeline 2111.01. Figure 7 shows a example schematic of the numbering system.

Each delivery system component is divided into segments. A segment is that part of the canal, stream or pipeline from one delivery system discharge point to the next delivery system discharge point. That is from a lateral top the next lateral. The lateral may be a canal, stream, or pipeline.

GRAND PRAIRIE DELIVERY SYSTEM MAIN CHANNELS

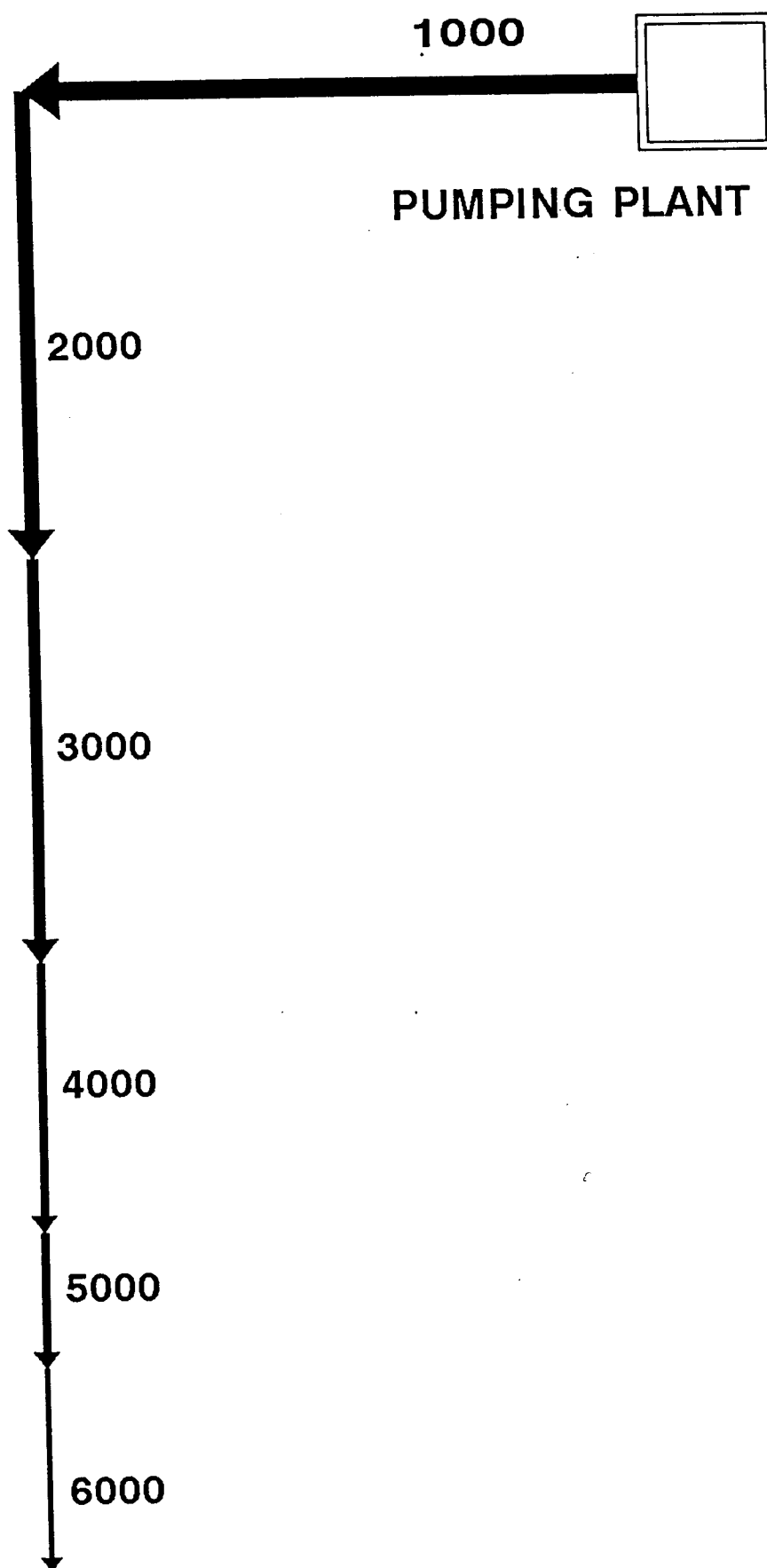


Figure 5

GRAND PRAIRIE DELIVERY SYSTEM MAINS and LATERALS

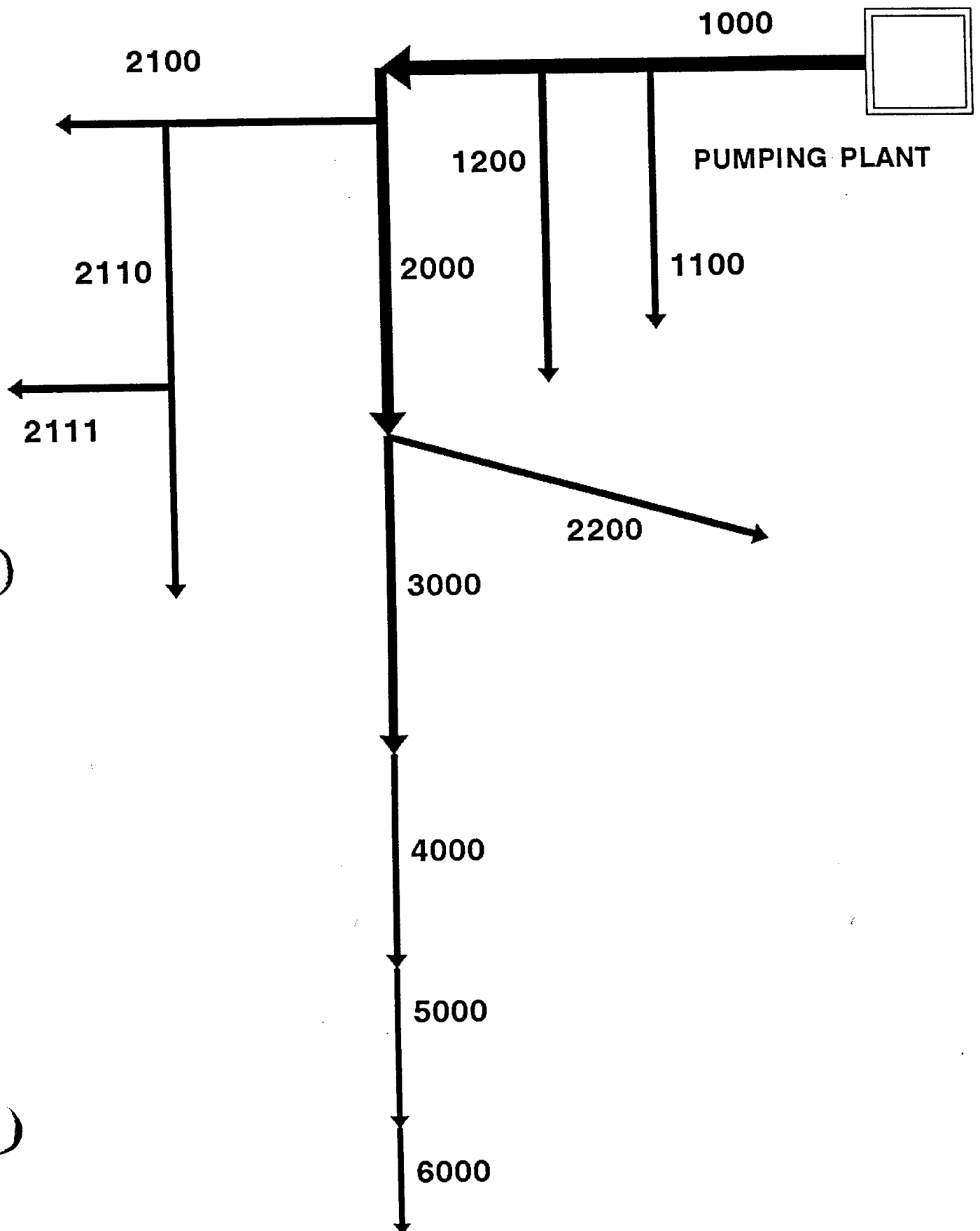


Figure 6

GRAND PRAIRIE DELIVERY SYSTEM MAINS,LATERALS,PIPELINES

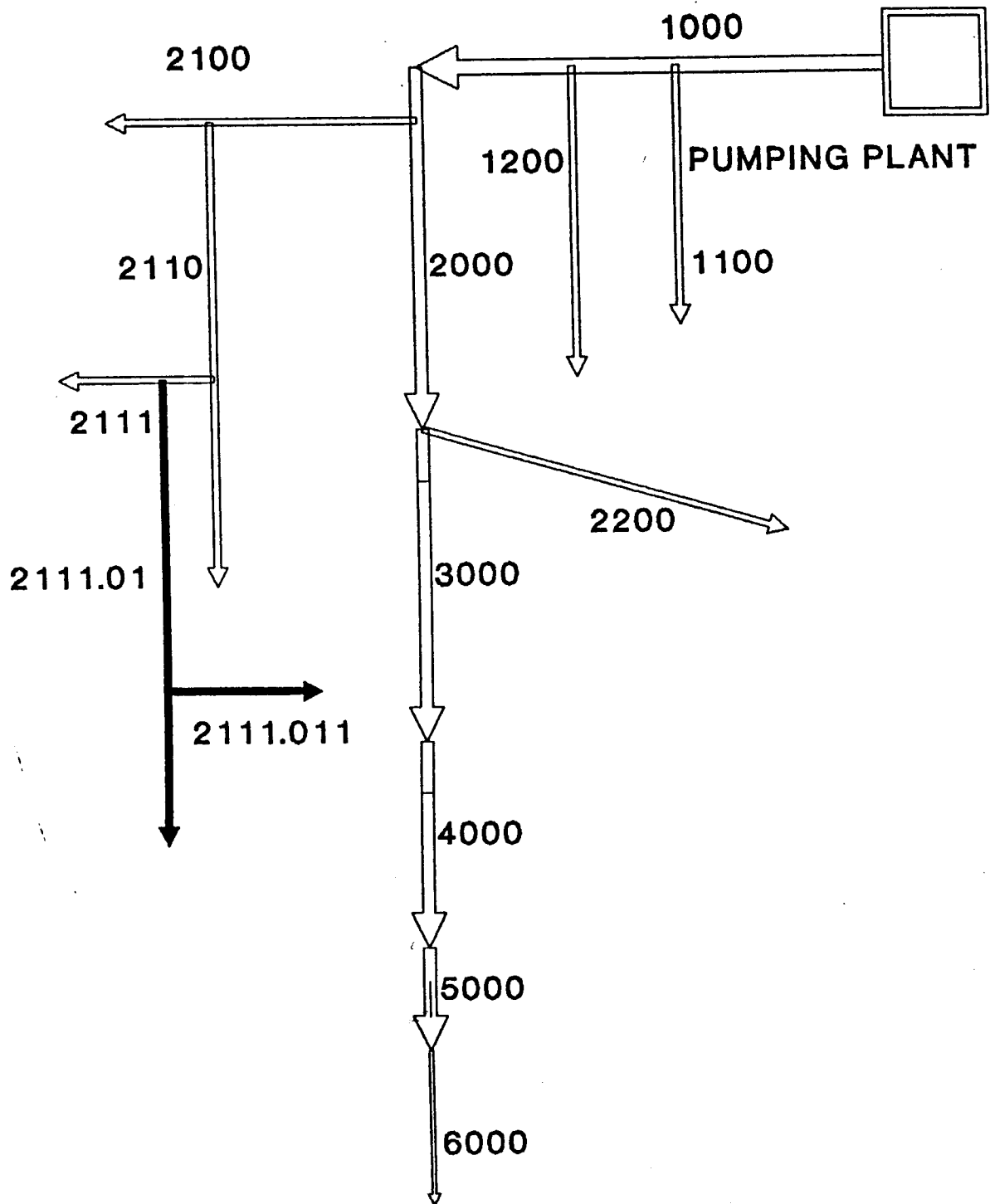


Figure 7

GRAND PRAIRIE DELIVERY SYSTEM CHANNEL SEGMENTS

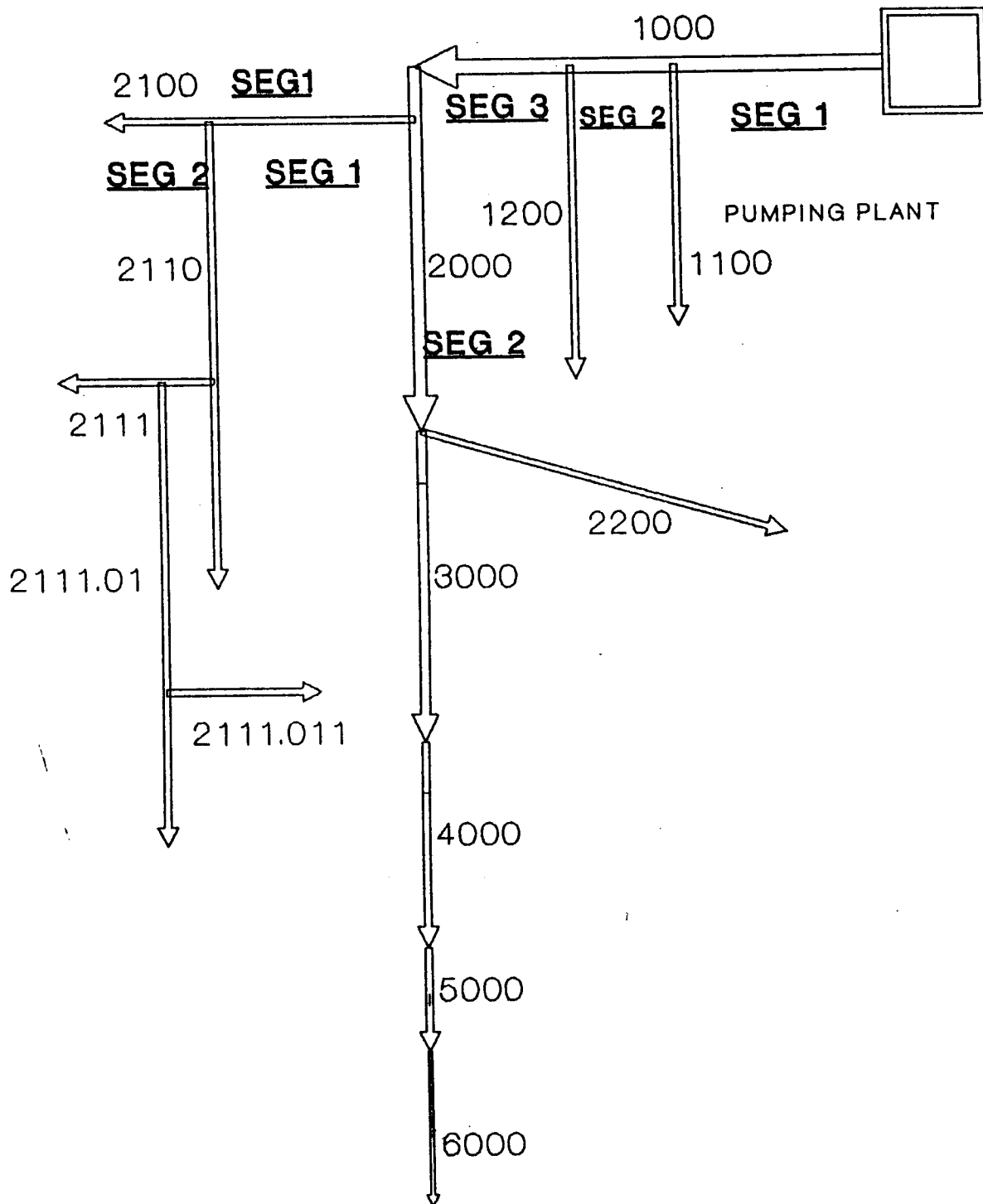


Figure 8

All canals, streams and pipelines have a segment numbering system in which segments are numbered consecutively beginning at the source canal, stream, or pipeline with segment one and continuing downstream. See Figure 8 for a schematic showing an example of the segment numbering system.

SECTION I

COMPUTER MODELS

EXISTING COMPUTER MODELS

In order to determine water needs for each tract within the project, several existing computer models were used in conjunction with several newly developed models.

Crop irrigation water requirements were determined using a NRCS program called CONUSE. This is a computational program based on the modified Blaney-Criddle method for determining consumptive use for various crops under varying climatic conditions. The specific method is contained in SCS Technical Release No. 21, "Irrigation Water Requirements" (SCS 1970). This procedure is the accepted method for determining plant water use in the humid southern United States.

CONUSE was run for each of the major crops grown in the project area using the following parameters:

1. The primary crops produced in the project area are: rice, soybeans, grain sorghum, corn, wheat, and oats.
2. Soybean acreages were divided into two categories. Early soybeans which are typically planted early in the growing season and require the entire growing season to produce acceptable yields. Late soybeans are typically planted following the harvest of wheat or oats in a double crop rotation.
3. Rainfall and temperature data was based on monthly totals for a 16 year period of record from 1965 through 1981 at the Stuttgart, AR reporting station. (See Appendix D)
4. Soil moisture holding capacities and irrigation characteristics were considered uniform throughout the project area. Typical soils in the Grand Prairie are silt loams near the surface with a hardpan located 12 to 24 inches below the surface.
5. Crop planting and harvest dates were considered the same throughout the project area and were obtained from the NRCS State Agronomist as per East Arkansas Planting Guides.

The CONUSE computer program and normal year climatic data were used to compute the monthly consumptive use and net irrigation requirement for the major crops produced in the project area. The results were used in the NRCS water budget program to compute individual tract water needs. These computations were later revised to 10 day values at the request of the Corps of Engineers due to low river flows during the peak irrigation period.

In order to predict future (with project) groundwater availability the output data of the USGS-Corps of Engineers (Peralta) groundwater model was used. In order to duplicate, as near as possible, current trends in irrigated agriculture in the Grand Prairie the 2030 SMA model runs were selected which is based on a 10 year pumping demand (without improvements in conservation). The 2030 SMA model run represent a pumping scenario that is limited by a minimum aquifer saturated thickness of 20 feet including any municipal and industrial use. The 2030 pumping demand is approximately equivalent to present conditions and is slightly less than maximum potential demand as expressed in 2040 data. At the present time this is the only groundwater data available and is considered conservative for project planning. Peralta model results are in the form of annual acre-feet of water availability per 9 square mile cells. The resulting groundwater availability values were used as an input table for use in the NRCS water budget model.

A Project Cell Analysis program developed by NRCS in the initial Feasibility Study was used in the Reevaluation Study to confirm and refine old data specific to the new proposed project boundaries. The program, based on the 9 square mile cells as per the Peralta Model, uses the surface water and groundwater data, water demands, available storage and conservation levels to establish the overall project import needs and peak import capacities. This program is general in nature and is not based on specific water demands per tract. It is adequate for establishing project alternatives and selecting target values to use in the NRCS water budget model. Target values include storage as a percent of demand and conservation levels that can be achieved. For more information on this program refer to NRCS report to the Corp of Engineers contained in the Eastern Arkansas Region Comprehensive Study (EARCS) Feasibility Report.

NEW MODELS

A comprehensive monthly water budget program was developed for this project in order to integrate land use, water demands, existing on-farm storage, planned storage, potential tailwater (runoff) capture, groundwater availability, and import needs for each tract of cultivated land in the project area.

A simple explanation of this model is that water demand, existing water supplies, and potential water supplies are compared on a 10 day basis in order to determine (1) total import needs (acre-feet) and (2) peak delivery capacity (cubic feet per second) that

SCS WATER BUDGET FLOW CHART

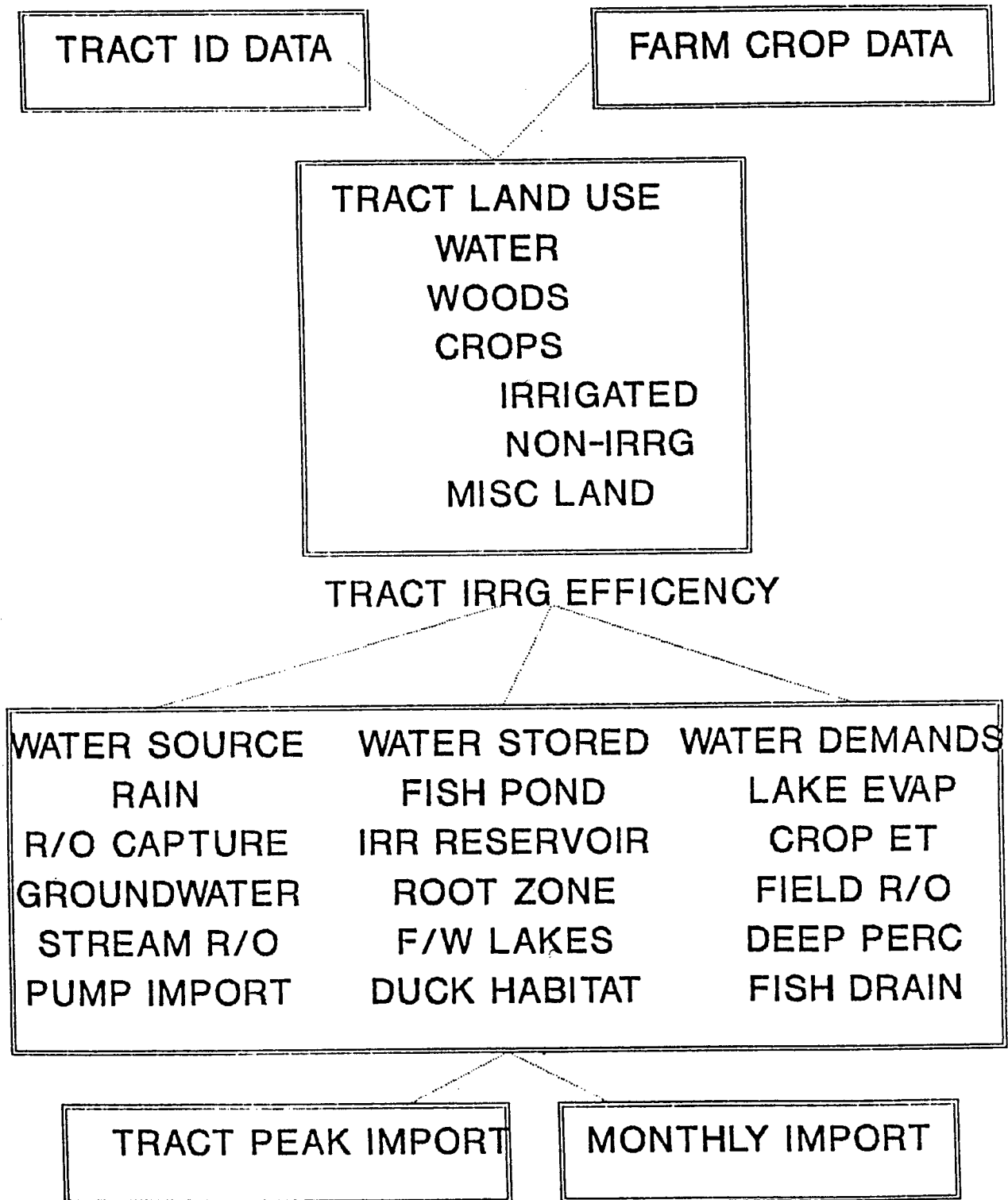


Figure 9

is required for each tract under project conditions. The input data of the water budget program is a database of information which includes land use and existing water storage for all tracts in the project.

Land Use

In order to determine specific land use on a tract, a computational procedure was followed that assumes crops will be grown on each tract according to the same ratio as ASCS crop base acres for the entire farm. For example, a farm may consist of several tracts as explained in the data assembly section of this report; however, ASCS base acreage are established on a total farm basis. Rice acreage, for example, is determined on the tract as being the farm rice base divided by the farm cropland times the tract cropland. The same procedure is followed for each of the other base crops. Soybeans is not a base crop, therefore, it is computed as the remaining cropland after all other summer crops are subtracted out. The wheat and oat base acreage was used to establish late season (double crop) soybeans. Fish pond acreage was determined by map measurements and is considered a crop with water requirements.

Other water bodies in the data base were identified by map measurement and include fish and wildlife lakes, treatment lagoons and irrigation reservoirs. The average depth of each reservoir was estimated in order to compute existing storage available for irrigation. If a reservoir serves more than one tract, an estimated portion of the stored water was assigned to each tract served.

Irrigation Efficiencies

An important aspect of determining water needed per tract is the efficiency of delivering and applying water to the crops being irrigated. Irrigation application efficiency is defined as the amount of applied water that benefits the crop divided by the total amount of water applied. It is an indicator of the water loss due to levee seepage, evaporation, deep percolation and tailwater runoff. Based on previous analysis in the EARCS feasibility study and irrigation studies conducted in eastern Arkansas since 1984 as part of the EAWCP, the average existing efficiency of water application was estimated to be uniform throughout the project area at 60 percent.

Potential improvements in water application efficiencies will be made possible as part of the overall project by installing water conservation practices and utilizing water management techniques. Conservation analysis on typical cells and comparison of benefits and costs have shown that an improvement of about 10 percent can realistically be achieved. Therefore, the potential (with project) demands were based on a project wide 70 percent efficiency in water applications.

Water Demands

Existing monthly crop water needs is computed using the results of the CONUSE (crop irrigation requirements) program along with the specific crop acres as previously determined for each tract. Tract water needs, other than crop requirements, are also computed as part of the total tract water demands per 10 day period. This includes evaporation losses from irrigation reservoirs, fish ponds and other water bodies. The off-season (non-cropping season) water demands for such items as reservoirs filling and flooding for waterfowl habitat is also computed as part of the total yearly water demands.

Both existing (1992 inventory) and future (with project) water demands are computed from the same base land use data. The assumptions used to adjust existing to future water demands are as follows:

- 1) All planned irrigation reservoirs, set as a target requirement for with-project conditions, will be constructed on cropland only, thus reducing irrigated acreage.
- 2) The priority of cropland reduction for reservoir construction will be full season soybeans, late soybeans, and rice.
- 3) No changes in woodland acreage will occur.
- 4) There will be no increase in cropland acres or crop distribution changes in the project area.
- 5) Under project conditions, there will be an estimated increase in winter waterfowl habitat due to flooding 10 percent of the cropland not previously flooded. The volume of water required to flood for waterfowl is estimated at an average depth of 6 inches over the area flooded. The months of October and November are assumed to be the months when habitat flooding occurs. This was later revised to November and December.

Existing and future (with project) total water demands per tract were calculated on a 10 day basis and summed in two separate demand tables, the results of which are used in the tract water budget calculations.

The net changes in water demands due to the project are:

1. In-season demand decreases due to new reservoir construction on previously irrigated land.
2. Off-season demand increases due to winter waterfowl flooding.

GRAND PRAIRIE REEVALUATION

IMPORT/DEMAND CURVES

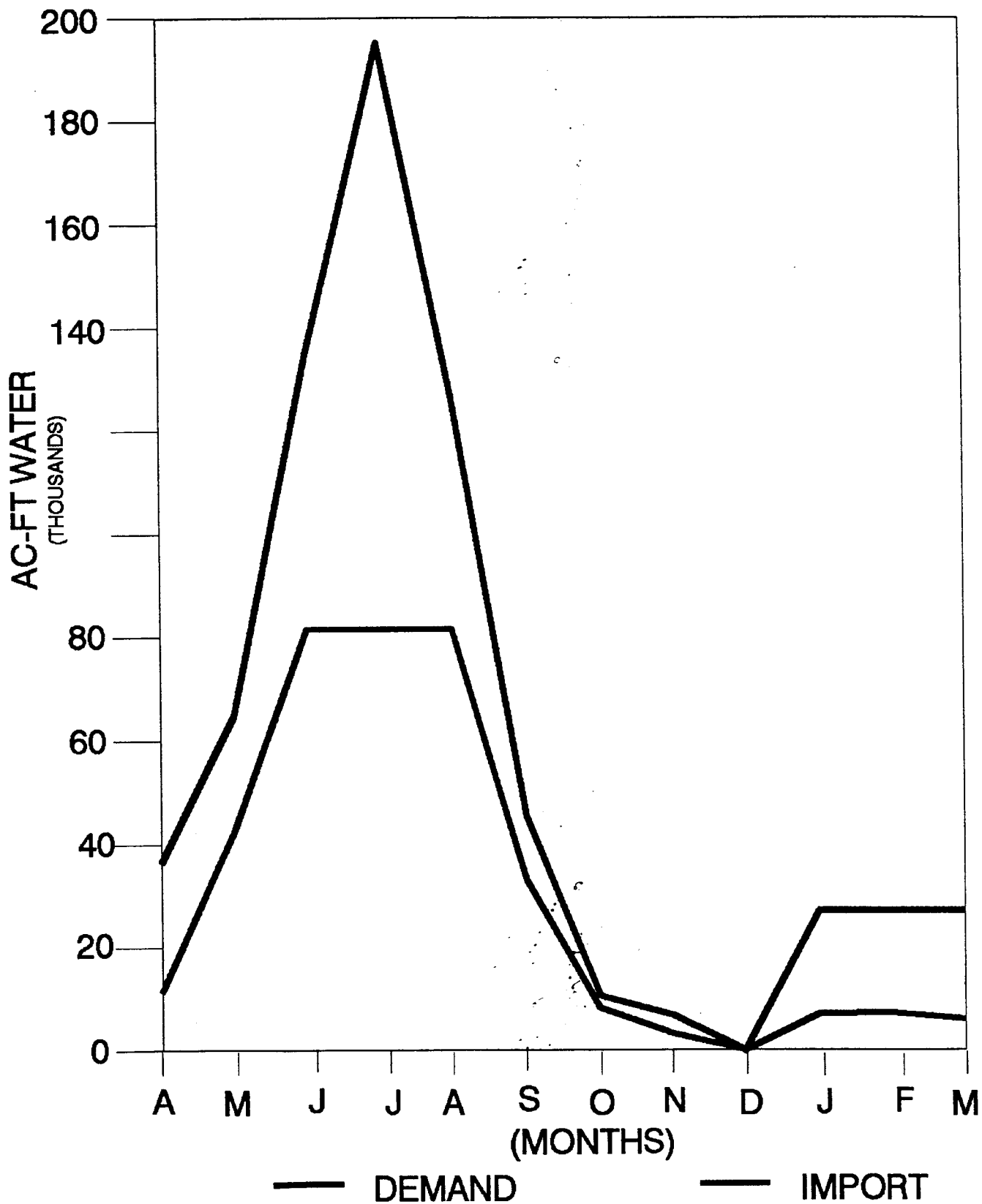


FIGURE 12

Water Supply

The next step employed in the water budget model is to calculate potential water demands.

Groundwater

In order to reduce groundwater withdrawal to sustainable levels, a limit or fixed value of available groundwater was used in the with project (potential) water supply computations. The value used for each tract is derived from the cell location of each tract with the available groundwater being that predicted in the Peralta 2030 SMA run proportioned down from the 9 square mile cell to the irrigated acres on the tract being computed.

Runoff Capture

The potential runoff capture is based on the irrigated acres and was computed as a percentage of the monthly rainfall. (See Appendix D). Runoff capture is considered available for meeting both in-season demands.

Storage

Storage available for irrigation is based on the target parameters established as 25 percent of the demand which includes existing storage, storage available from reservoirs on other tracts (off-tract) and planned reservoirs on the tract being considered. Adjustments are made when existing storage and/or off-tract water exceeds 25 percent of the demand. This water is considered available throughout the cropping season on an as-need and as-available basis, after other surface water sources fail to meet the monthly demands.

Import Water

Import water (stream diversion) will be used to fulfill monthly demands after considering all other supply sources according to the target parameters established for the project. The total volume of import water is computed as the reduced demand after conservation improvements, less tailwater capture, less available storage, less target level groundwater. In order to determine the monthly volumes of import while minimizing the flow capacities, a three step water budget process is used.

Approximate 10 day import rates are estimated in the **first step** using the hypothesis that the import curve during the cropping season will follow a trapezoidal shape.

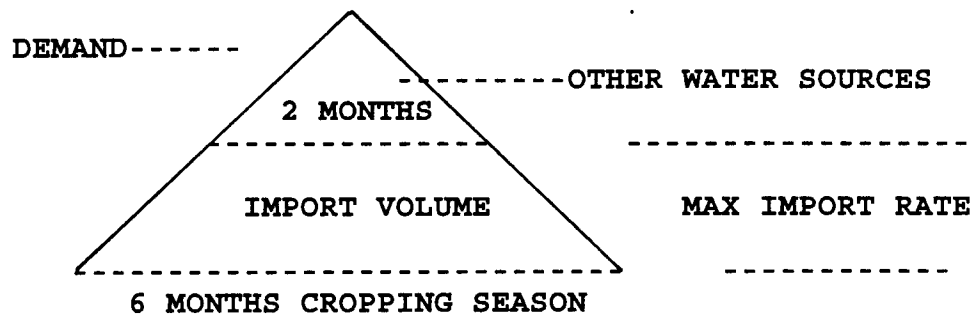


FIGURE 11

The **second step** is to use the approximate 10 day import rates along with runoff capture, storage, and groundwater to compute a monthly water budget distribution. For these calculations storage is considered available from May through December (January to April are refill months). Groundwater is not considered available until June which is the month when other water sources normally run short. The bottom line of these calculations is an adjusted import need per 10 day period computed as the approximate values used above, plus any unmet demands for each period after all sources are exhausted.

The **third step** in minimizing import capacities is a final 10 day water budget computation setting the priority of water use as that which will normally be used by most water users in the project. Tailwater capture will be the first water used to meet demands. Import water will be utilized next until it no longer fulfills the need. Storage will then be used until exhausted and finally groundwater will be pumped to complete the requirements for meeting water demands. Import values used during the cropping season in this step is limited to a value computed as the average of the 10 day import values for June, July, and August computed in the second step iteration.

Results

The NRCS water budget model results are compiled in the GP.OUT output file. A single page example printout of this file is included in Appendix H.

The GP.OUT file and a file called DITCHILDREN.DAT file (See Appendix I) are used in computing the delivery system capacities in the NRCS NETWORK program.

NETWORK PROGRAM

The NETWORK program was developed to determine the flow rates required for each individual segment of the delivery system. Each tract was assigned an import water source located on a segment along a canal, stream, or pipeline. Segment flow rates (Q's) are determined by totaling Q's required for each of the tracts served by that segment plus the sum of Q's for any extensions or laterals serving other tracts.

Delivery system seepage and evaporation losses are not included in these totals. The Corps of Engineers made seepage and evaporation estimates for the delivery system and increase the design Q's as required.

SECTION J

CONCLUSIONS

The analysis of the project in this phase of the work indicates a peak import water requirement of approximately 1,132 cubic feet per second (without losses) which would be withdrawn from the White River near DeValls Bluff. This would protect the groundwater resource, provide for fish and wildlife habitat enhancement and allow the continued irrigation of approximately 240,000 acres of cultivated cropland.

Water use would be reduced by increased efficiencies due to improved management practices and the installation of conservation practices. Water would be supplied by a combination of on-farm surface runoff, on-farm storage reservoirs, imported surface water from the White River, and groundwater.

These withdrawal rates were analyzed by the Corps of Engineers and NRCS to determine the availability and reliability of White River as a source of water. (See Hydraulics section)

The project appears to be a viable project and warrants moving into the design and implementation phase of the project.

APPENDIX A

INTERAGENCY AGREEMENTS

UNITED STATES
DEPARTMENT OF
AGRICULTURE

Soil
Conservation
Service

Room 5404 Federal Office Building
700 West Capitol Avenue
Little Rock, Arkansas 72201

MAR 27 1992

Colonel Clinton W. Willer
District Engineer
Memphis District, Corps of Engineers
B-202 Clifford Davis Federal Building
Memphis, Tennessee 38103-1894


Dear Colonel Willer:

This letter constitutes my approval of the Scope of Work for Soil Conservation Service participation in the Eastern Arkansas Region Comprehensive Study, Grand Prairie Area Demonstration Project - General Reevaluation, which you sent to me for review.

I have enclosed a copy of our proposal with the time and cost estimate to perform our activities as you requested. The cost estimate for each activity includes salary costs, overhead, miscellaneous supplies, and travel. To simplify the billing process, we plan to submit our bill every quarter on an SF1080.

If I may be of further assistance, please contact my office or call Dennis Carman, state conservation engineer, at telephone number 501-324-5443 or FTS 740-5443.

Sincerely,

 Acting for
RONNIE D. MURPHY
State Conservationist

Enclosures

bc: (w/encls.)
Robert Cantrell, ASTC(WR), SCS, Little Rock
Jimmy Rietzke, AWRSL, SCS, Little Rock
Ray Linder, AC, SCS, Monticello
Pat Bass, ASCE, SCS, Little Rock

USDA:SCS:DCARMAN:sav:3/25/92

EAST ARKANSAS REGION COMPREHENSIVE STUDY
GRAND PRAIRIE AREA REEVALUATION

MARCH 26, 1992
SOIL CONSERVATION SERVICE
SCOPE OF WORK FOR FISCAL YEAR 1992

PURPOSE:

The purpose of this document is to provide a written narrative of work items that must be completed during the initial phase of the Grand Prairie Area Reevaluation by the Soil Conservation Service (SCS) in FY-92, beginning in January 1992 and completed in September 1992. This document should be used in conjunction with other documents entitled "Plan of Work for the Soil Conservation Service Participation, Supplement No. 1" that indicates the planning steps, work items, product, time requirements, cost, and starting and completion dates. For more specific information on the methodology, assumptions, work items, and work products refer to the document entitled "Scope of Work, Supplement No. 2".

SCS PARTICIPATION:

SCS participation in the study effort will be to conduct all on-farm data collection, planning, and analysis as well as planning, analyzing, locating and designing a water conveyance network that distributes irrigation water from the Memphis District Corps of Engineers (MDCOE) channel network to each farm or group of farms (to farm network). This to farm water conveyance network will provide the information necessary for MDCOE to determine the location of the final alignment for the main delivery channel network as well as the necessary flow rates to meet the water needs of the project area.

SCS SCOPE OF WORK FOR FY-92:

The first step in the evaluation effort is for the MDCOE and SCS to jointly agree on the highest priority area to start the evaluation. SCS will review farm plans or other available records and possibly field investigation to inventory farm data for planning. SCS will verify the farm boundary to determine farm unit size, farm unit name or id, irrigated crops (rice and other crops), existing storage, and the delivery point to the farming unit. This information will be recorded on a worksheet and on aerial photos provided by the MDCOE. The estimated cost including travel for this inventory in FY-92 is \$89,000. This inventory does not provide all the data needed for the on farm planning. Additional on farm inventory will be required in FY-93 to analyze the alternatives.

SCS will calculate the farming unit water needs using assumptions concerning storage requirements, achievable water use efficiency, and groundwater availability. These assumptions have been discussed and concurred with the MDCOE. The details on the assumptions will be documented in the detailed Scope of Work, Supplement No. 2. An analysis of groups of farming units will be performed to identify the delivery network location and required "Q" for these groups of farming units for the primary distribution system. A preliminary secondary delivery network may also be identified during this process. SCS will provide to the MDCOE via base map or digital map the proposed main delivery network location with specific location for water diversion from the main delivery network with the required diversion "Q". The estimated cost including travel for this portion of the evaluation in FY-92 is \$88,600.

The first delivery of information for the highest priority area will be provided by July 15, 1992. Additional deliveries of information will be provided by August 15 and September 15 with the total network and segment "Q" by October 1, 1992. The total main delivery system would then be proposed to the MDCOE. Any needed changes or revisions would be made with adjustments made in the "Q" requirements based on any changes in the proposed main delivery system location.

The SCS will review and revise, in detail, the Operational Plan presented in the East Arkansas Region Comprehensive Study Report. A preliminary review and response to specific questions raised by the MDCOE with a draft of the Operational Plan should be completed by August 15, 1992. Many of the questions raised by the MDCOE cannot be resolved until the "hydraulic model" is working and can be analyzed. Additional consultation with the MDCOE will occur during the development and implementation of the "hydraulic model" depending on MDCOE schedule. Completion of the plan is expected by October 1, 1992. The Operational Plan cannot be finalized until the "hydraulic model" has been analyzed to correct operational deficiencies. The estimated cost for the draft Operational Plan in FY-92 is \$22,400.

SUMMARY:

The total estimated cost for the Soil Conservation Service participation in FY-92 is \$200,000. For more details on SCS participation duties, refer to the "Plan of Work for the Soil Conservation Service Participation, Supplement No. 1" and the "Scope of Work, Supplement No. 2".

EASTERN ARKANSAS COMPREHENSIVE STUDY
 GRAND PRAIRIE AREA REEVALUATION
 PLAN OF WORK FOR THE SOIL CONSERVATION SERVICE PARTICIPATION, SUPPLEMENT NO. 1
 REVISED 3/26/92

PLANNING STEP	WORK ITEM	PRODUCT	DURATION MONTHS/PERSONS	PERSON DAYS	COST	START DATE	COMPLETE DATE
I. IDENTIFICATION OF WATER AND RELATED LAND RESOURCE PROBLEMS AND OPPORTUNITIES. CONTINUE SCOPING PROCESS.	A. REVIEW AND VERIFY PREVIOUS DATA FROM THE FEASIBILITY STUDY						
	1. GROUNDWATER AVAILABILITY	VERIFY	.05/2	2		4/13/92	
	2. LAND & WATER USE PROJECTIONS	VERIFY	.05/2	2		4/14/92	
	3. PROJECT OBJECTIVES & BOUNDARIES	VERIFY	.05/2	2		4/15/92	
	4. ALTERNATIVE CONSIDERATIONS & ID HIGHEST PRIORITY AREA (MDCOE)	POTENTIAL ALTERNATIVES & STARTING AREA (MEETING WITH MDCOE)	.05/4	4		4/16/92	4/17/92
		TOTAL I.A.		10	3300	4/13/92	4/17/92
	B. REEVALUATION PLANNING EFFORTS						
	1. STRATEGIES, METHODS, & ASSUMPTIONS	1. ASSUMPTIONS DOCUMENTED	.1/6	12		4/20/92	4/21/92
	2. COST ESTIMATES & SCHEDULE	1. COST AND SCHEDULES	.1/2	4		4/21/92	4/22/92
	3. STAFF SELECTIONS AND TRAINING		.5/2	10		4/20/92	5/1/92
	4. PLANNING DETAILS	1. MANAGEMENT UNIT FOR EVALUATION, INVENTORY WORKSHEETS, ETC.	.5/2	10		4/27/92	5/1/92
		SUBTOTAL I.B. IN FY-92		36	12000	4/20/92	5/1/92
	STEPS 1-4 ABOVE IN FY-93	SUBTOTAL I.B. IN FY-93		30	10000	10/5/92	10/16/92
		TOTAL I.B.		66	22000		
	C. ASSEMBLE PLANNING MATERIAL						
	1. REQUIRED MAPS, PHOTOS, ETC.	1. WORKING FILES	.1/2	4	1700	4/20/92	4/21/92
	2. COMPUTER SOFTWARE & HARDWARE						

PLANNING STEP	WORK ITEM	PRODUCT	DURATION MONTHS/PERSONS	PERSON DAYS	COST	START DATE	COMPLETE DATE
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I. CONTINUED

D. DETERMINE PUBLIC'S PERCEPTION OF REEVALUATION STUDY.

- 1. ENCOURAGE INVOLVEMENT OF OTHER AGENCIES IN DETERMINING RESOURCE CONCERNS.
- 2. PUBLIC AND/OR SPONSOR MEETING

- 1. PUBLIC/SPONSORS CONCERNS
- 2. AFFIRMATION OF PROJECT AREA

4

SCHEDULED BY
MOCOE

2

TOTAL I.D.

6

2000

FY-93

TOTAL FOR PLANNING STEP 1 IN FY-92.

50

17000

TOTAL FOR PLANNING STEP 1 IN FY-93.

36

12000

TOTAL FOR PLANNING STEP 1.

86

29000

PLANNING STEP	WORK ITEM	PRODUCT	DURATION MONTH/PERSONS	PERSON DAYS	COST	START DATE	COMPLETION DATE
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II. INVENTORY, FORECAST,
AND ANALYZE WATER
AND RELATED RESOURCE
CONDITIONS WITHIN THE
PLANNING AREA RELEVANT
TO THE IDENTIFIED
PROBLEMS AND OPPOR-
TUNITIES. CONTINUE
SCOPING PROCESS.

A. ON FARM INVENTORY FOR PLANNING.
APPROX. 352,000 ACRES - 1000 FARMS
1. ACTUAL FARM INVENTORIES OF
EXISTING & POTENTIAL RESOURCES
(USING MAPS AND/OR ON SITE)
a. FOR ENGINEERING EVALUATION

1. FARMING UNIT SIZE/BOUNDARY						5/4/92	9/11/92
2. CROP DISTRIBUTION IRRIGATED/NON IRRIGATED						5/4/92	9/11/92
3. EXISTING STORAGE						5/4/92	9/11/92
4. IMPORT LOCATIONS						10/92	1/93
5. POTENTIAL STORAGE						10/92	1/93
6. EXISTING IRRIGATION METHODS						10/92	1/93
7. POTENTIAL IRRIGATION METHODS						10/92	1/93
8. EXISTING IRRIGATION SYSTEMS						10/92	1/93
9. POTENTIAL IRRIGATION SYSTEMS						10/92	1/93
10. EXISTING WATER CONSERVATION PRACTICES						10/92	1/93
11. POTENTIAL WATER CONSERVATION PRACTICES						10/92	1/93
SUBTOTAL II. A.1.a. FY-92	5/7		410	89000	5/4/92	9/11/92	
SUBTOTAL II. A.1.a. FY-93	4/4		330	72000	10/92	1/93	
TOTAL II. A.1.a.			740	161000			

PLANNING STEP	WORK ITEM	PRODUCT	DURATION MONTH/PERSONS	PERSON DAYS	COST	START DATE	COMPLE DATE
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II. CONTINUED	b. FOR ECONOMIC AND CONSERVATION EVALUATION	1. ECONOMIC CONDITIONS				10/92	10/92
		2. SOCIAL CONDITIONS					
		3. MINORITIES					
		4. UPDATE LAND USE					
		5. FARMING UNIT SIZE					
		6. UPDATE CROP YIELDS					
		7. ONGOING CONSERVATION PROGRAMS					
		8. PRESENT CONSERVATION LEVEL					
		TOTAL II.A.1.b.	.25/1	5	1700	10/92	10/92
	B. DEVELOP/UPDATE PROJECT DATA BASE AND MAPS	1. SOILS INFORMATION				10/92	4/94
		2. PRIME AND UNIQUE FARMLAND					
		3. FSA WETLANDS IDENTIFICATION					
		4. DATA FOR ENVIRONMENTAL, AND CULTURAL RESOURCE TO MDCOE FOR ASSESSMENT					
		SUBTOTAL II.B. FY-93	4/3.5	330	78800	10/92	1/93
		SUBTOTAL II.B. FY-94	8/3.5	570	135700	10/93	5/94
		TOTAL II.B.		900	214500		

PLANNING STEP	WORK ITEM	PRODUCT	DURATION MONTH/PERSONS	PERSON DAYS	COST	START DATE	COMPLE. DATE
II. CONTINUED	C. REFINE ECONOMIC & SOCIAL CONDITIONS						
	1. ECONOMIC BASE	1. SOCIAL & ECONOMIC CONDITIONS				11/92	3/93
	2. CROPPING PATTERNS, IRRIGATION TRENDS, CROP BUDGETS, ETC.	1. PAST, EXISTING, PROJECTIONS 2. EVALUATION UNITS 3. DETERMINE PRESENT CONDITIONS					
		TOTAL II.C.	5/1	100	33000	11/92	3/93
	D. ON FARM PLANNING						
	1. WATER BUDGET CALCULATIONS	1. IMPORT "Q" FOR FARM 2. TOTAL "Q" FOR FARM 3. LOCATION OF FARM DELIVERY POINT				5/11/92	9/18/92
						5/11/92	9/18/92
						5/11/92	9/18/92
	2. CONSERVATION PRACTICES (PRESENT & POTENTIAL)	1. PRACTICES NEEDED a. LENGTH (PIPELINE, ETC.) b. VOLUMES c. COST 2. POTENTIAL STORAGE 3. COST FOR CONSERVATION PRACTICES				11/92	5/93
						11/92	5/93
						11/92	5/93
		SUBTOTAL II.D. FY-92	4/2.5	180	36000	5/11/92	9/18/92
		SUBTOTAL II.D. FY-93	7/4.5	730	164000	11/92	5/93
		TOTAL II.D.		910	200000		

PLANNING STEP	WORK ITEM	PRODUCT	DURATION MONTH/PERSONS	PERSON DAYS	COST	START DATE	COMPLE DATE
II. CONTINUED	E. BASE MAP WITH LOCATION OF TO-FARM DELIVERY SYSTEM (LAYOUT)	1. FINAL SYSTEM ALIGNMENT WITH "Q's"	5/4	205	52600	5/18/92	9/25/92
	F. OPERATIONAL PLAN FOR THE SYSTEM (UPDATE & REVISE ASWCC PLAN)	1. DRAFT OPERATIONAL PLAN FOR "HYDRAULIC MODEL"	1.25/3	75	22400	6/1/92	9/30/92
	G. ANALYZE FARM IMPORT MAP FOR TO FARM CHANNELS/IRRIGATION PIPELINES (DELIVERY NETWORK)	1. ESTABLISH TO FARM DELIVERY NETWORK COMPONENTS	3/3.5	200	47900	4/93	6/93
	H. ENGINEERING SURVEYS FOR TO FARM DELIVERY.	1. DATA FOR ANALYSIS, QUANTITIES, & DESIGN	9/3.5			10/92	6/93
	1. PERMITS FOR SURVEYING	a. SECONDARY STRUCTURES	3/3.5			10/93	12/93
	2. CHANNELS/STREAMS/DITCHES	b. DELIVERY PIPELINES					
	3. STRUCTURES						
	4. PIPELINES						
		SUBTOTAL II.H. FY-93		625	150000	10/92	6/93
		SUBTOTAL II.H. FY-94		210	50000	10/93	12/93
		TOTAL II.H.		835	200000		

PLANNING STEPS	WORK ITEM	PRODUCT	DURATION MONTH/PERSONS	PERSON DAYS	COST	START DATE	COMPLET DATE
II. CONTINUED	I. HYDROLOGY/HYDRAULICS EVALUATION	1. PRELIMINARY DESIGNS				2/93	5/93
		a. CHANNEL/CANALS				10/93	5/94
		b. TO-FARM PIPELINE					
		2. IDENTIFICATION OF WATER CONTROL STRUCTURE NEEDS.					
		SUBTOTAL II.I. FY-93	4/5.5	275	66700		
		SUBTOTAL II.I. FY-94	8/5.5	550	133300		
		TOTAL II.I.		825	200000		
	J. GEOTECHNICAL	1. GEOLOGIC INVESTIGATION	1.5/1	30	9900	10/93	12/93
	K. WATER CONTROL STRUCTURE SELECTION	1. STANDARD DESIGN SELECTION & LOCATION.	3/3	150	40000	6/94	8/94
	L. FORECAST FUTURE CONDITIONS OF RESOURCES INVENTORIED	1. ESTABLISHMENT OF FUTURE WITHOUT PROJECT CONDITIONS (BASIS FOR FORMULATING ALTERNATIVES)	.5/1	10	3300	4/93	4/93
		TOTAL FOR PLANNING STEP II IN FY-92		870	200000		
		TOTAL FOR PLANNING STEP II IN FY-93		2605	617400		
		TOTAL FOR PLANNING STEP II IN FY-94		1510	368900		
		TOTAL FOR PLANNING STEP II		4985	1186300		

PLANNING STEPS	WORK ITEM	PRODUCT	DURATION MONTH/PERSONS	PERSON DAYS	COST	START DATE	COMPLETION DATE
III. FORMULATION OF ALTERNATIVE PLANS. CONTINUE SCOPING PROCESS.	A. FORMULATE ALTERNATIVE PLANS 1. DETERMINE STRATEGIES THAT ADDRESS THE PUBLIC AND AGENCIES (MDCOE & SCS) CONCERNS. REVIEW ALTERNATIVES PREVIOUS DISCUSSED.	LIST OF ALTERNATIVES FORMULATED WITH CONSERVATION PRACTICES NEEDED	.25/6	22	6600	5/93	5/93
		TOTAL FOR PLANNING STEP III		22	6600	5/93	5/93
IV. EVALUATION OF EFFECTS OF ALTERNATIVE PLANS. CONTINUE SCOPING PROCESS.	A. EVALUATE ALTERNATIVE PLANS 1. PRELIMINARY DESIGN & COST ESTIMATES.	DETERMINATION OF COMPLETENESS, EFFECTIVENESS, AND EFFICIENCY OF EACH ALTERNATIVE FORMULATED. 1. DESIGN, QUANTITIES, AND COST ESTIMATE FOR EACH ALTERNATIVE a. TO-FARM CHANNEL/CANAL/ PIPELINE b. CONSERVATION PRACTICES	9/4.5	795	200000	10/93	6/94

PLANNING STEPS	WORK ITEM	PRODUCT	DURATION MONTH/PERSONS	PERSON DAYS	COST	START DATE	COMPLET DATE
IV. CONTINUED	2. EVALUATE PROVIDING DIFFERENT LEVELS OF CONSERVATION PRACTICES AND ENVIRONMENTAL QUALITY PROTECTION AND ENHANCEMENT.		1/3.5	70	23200	3/94	3/94
	3. ANALYZE EFFECTS AND IMPACTS	WETLANDS, ETC.	2/4	160	50000	4/94	5/94
	4. CONDUCT INCREMENTAL ANALYSIS/COP'S		4/2	160	52800	6/94	9/94
	5. DATA FOR ASSESSMENT TO MDCOE	MDCOE'S ASSESSMENTS	4/2	160	52800	6/94	9/94
	1. ENVIRONMENTAL						
	2. CULTURAL RESOURCES						
	3. WETLANDS IMPACTED						
	6. ECONOMIC EVALUATION OF COSTS AND BENEFITS		.25/1	5	1650	9/94	9/94
	B. RE-EVALUATE TO FARM DELIVERY SYSTEM TO SUPPORT 3 MDCOE ALTERNATIVES FOR OTHER CHANNEL SIZES THAT RESULT FROM VARIOUS LEVELS OF STORAGE.		3/3.5	210	50000	7/94	9/94
	1. RECOMPUTE/UPDATE	1. NEW QUANTITIES AND COST FOR					
	a. "Q"	1. TO-FARM DELIVERY					
	b. CHANNEL/PIPELINE DECISION	2. SURFACE STORAGE					
	c. STORAGE COST						
	d. TO-FARM QUANTITIES & COST						
	C. DETERMINE NED PLAN		.05/6	6	1650	9/94	9/94
		TOTAL FOR PLANNING STEP IV		1566	432100		

PLANNING STEP	WORK ITEM	PRODUCT	DURATION MONTH/PERSONS	PERSON DAYS	COST	START DATE	COMPLE. DATE
V. COMPARISON OF ALTERNATIVE PLANS	A. DEVELOP ALTERNATIVE TABLES	SPONSOR DISCUSSION OF ALTERNATIVES, DETERMINATION OF ACCEPTABILITY OF ALTERNATIVES BY SPONSORS, AND INDICATION IF PLAN WOULD BE ACCEPTABLE TO SPONSORS.				10/94	11/94
	B. DETERMINE SPONSORS & PUBLIC REACTION TO ALTERNATIVES						
	TOTAL FOR PLANNING STEP V		2/2.5	100	33000	10/94	11/94
VI. SELECTION OF RECOMMENDED PLAN BASED UPON COMPARISON OF ALTERNATIVE PLANS	A. SELECT THE NED PLAN OR ALTERNATIVE PLAN IF APPROPRIATE						11/94
	B. REVISE/UPDATE OPERATIONAL PLAN	1. FINAL OPERATIONAL PLAN	1.5/2.5	80	24300	11/94	12/94
	C. REVISE/UPDATE DESIGNS AND COST ESTIMATES	1. FINALIZE ENGINEERING PRACTICES	1.5/3.5	110	26700	12/94	1/95
	D. PREPARE DRAFT REPORT WITH INVESTIGATION AND ANALYSIS REPORT TO COE. 1. WRITING OF REPORT. 2. SCS STATE OFFICE REVIEW. 3. SEND DRAFT TO COE FOR REVIEW.		3/4	250	82600	1/95	3/95
	E. ASSIST COE WITH PUBLIC MEETING.						
	F. FINAL DOCUMENT TO COE.		1/6	80	26400	4/95	5/95
	TOTAL FOR PLANNING STEP VI			520	160000		
TOTAL FOR PLANNING STEPS:				7279	1847000		
TOTAL SCS COST BY FISCAL YEARS:						REIMBURSED BY MDCOE:	
FY-92				920	217000	200000	
FY-93				2663	636000	636000	
FY-94				3076	801000	801000	
FY-95				620	193000	193000	
TOTAL FOR SCS PLANNING PARTICIPATION				7279	1847000	1830000	

APPENDIX B

DATA BASE DISKS

APPENDIX C

CROP CONSUMPTIVE USE TABLES

USDA

SOIL CONSERVATION SERVICE

MODIFIED BLANEY-CRIDDLE CONSUMPTIVE USE
using a- 1 -HUMID AREA ADJUSTMENT FACTOR

STATION USED- STUTTGART, AR LATITUDE- 34 DEGREES 30 MINUTES
BEGINING OR PLANTING DATE-MAR 15 ENDING OR HARVEST DATE-AUG 25 NET IRRIG APPLIC.= 2 IN.
CROP-CORN-grain-----GSC # 19

MONTH	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
MEAN TEMP	42.9	47.0	54.5	64.8	72.1	79.1	82.7	81.6	75.3	64.6	53.4	45.9	
MEAN PRECIP	3.63	3.49	4.92	4.46	4.99	3.53	2.88	3.21	3.91	2.68	4.05	5.61	47.36
INCHES/MO	0.00	0.00	0.77	2.85	6.16	8.71	9.17	4.97	0.00	0.00	0.00	0.00	
CUM INCHES	0.00	0.00	0.77	3.62	9.78	18.49	27.66	32.63	0.00	0.00	0.00	0.00	32.63
INCHES/DAY	0.00	0.00	0.05	0.10	0.20	0.29	0.30	0.20	0.00	0.00	0.00	0.00	

PEAK USE

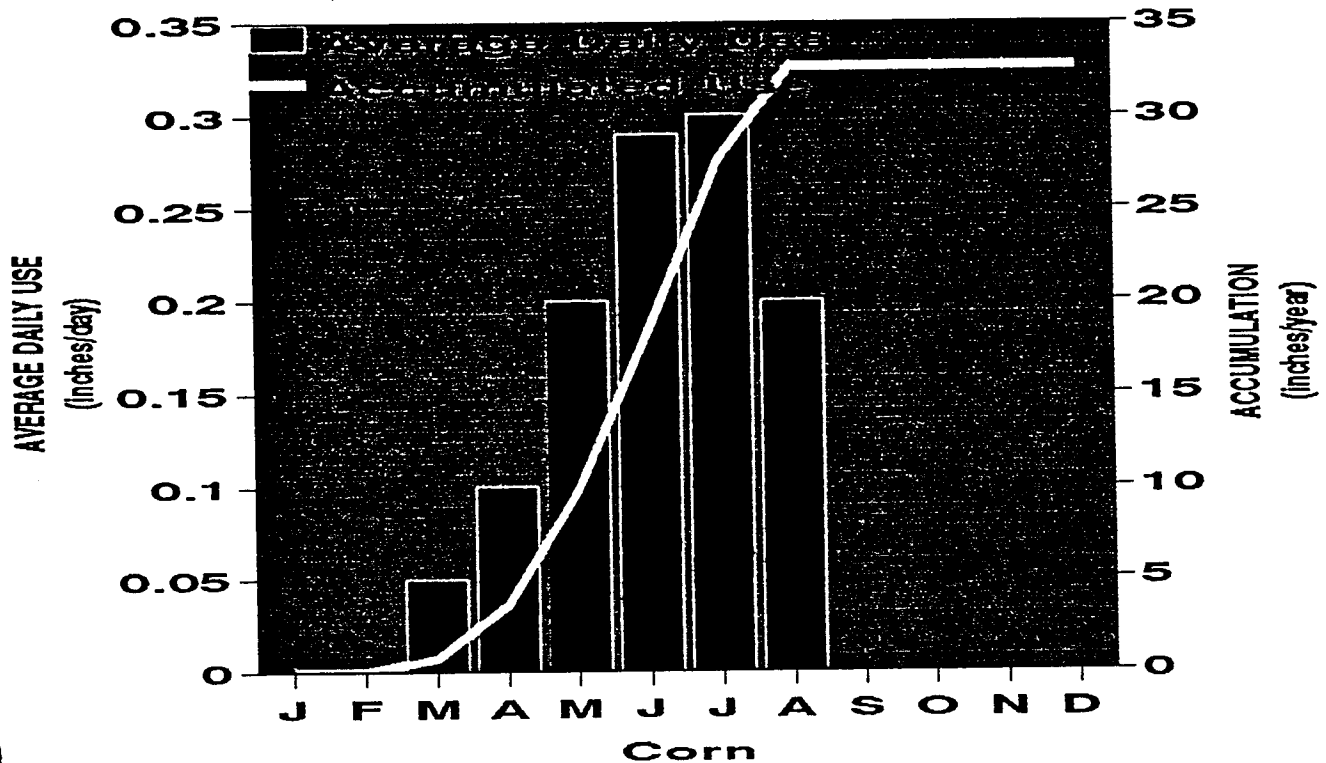
0.36 (INCHES/DAY)

(THE NET IRRIGATION REQUIREMENT IS COMPUTED LEAVING THE END OF SEASON SOIL MOISTURE AT 50% OF AVAILABLE WATERHOLDING
CAPACITY-THE INITIAL SOIL MOISTURE OF 3.00 INCHES WAS 75% OF AVAILABLE CAPACITY OF 4.00 INCHES)

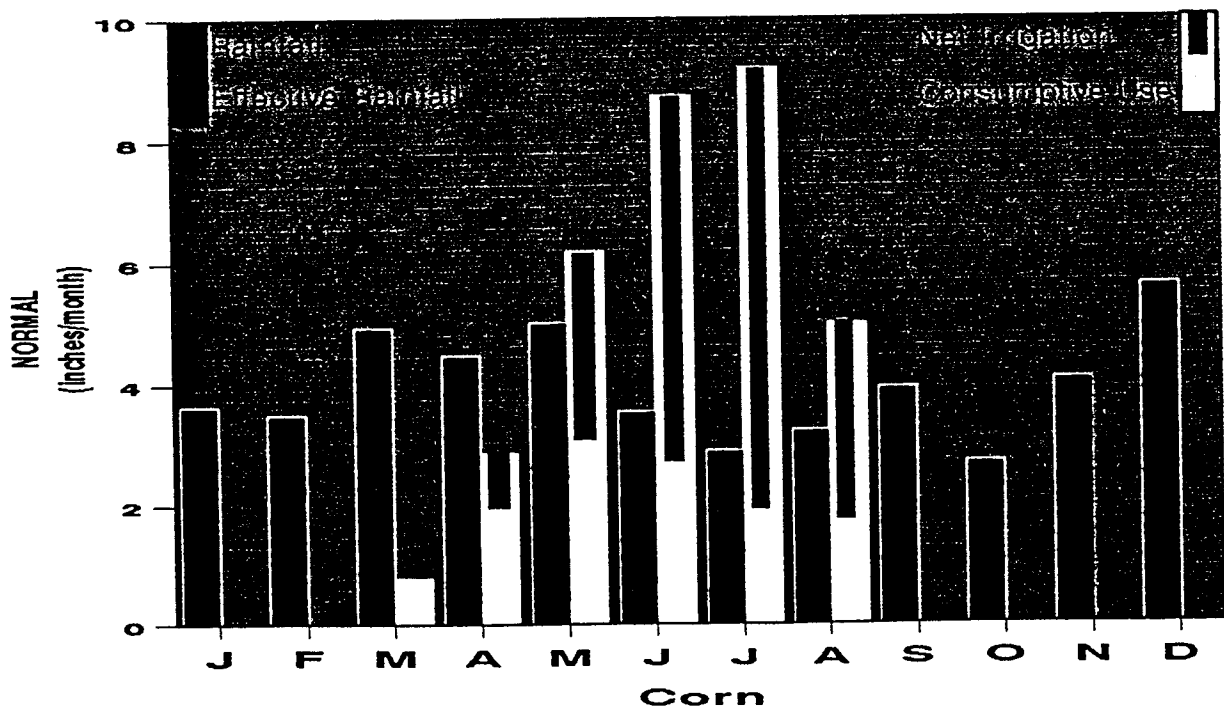
EFFECT RAIN	0.00	0.00	0.77	2.50	3.32	2.83	2.43	2.26	0.00	0.00	0.00	0.00	14.11
NET IRR REQ	0.00	0.00	0.00	0.35	2.84	5.88	6.74	1.71	0.00	0.00	0.00	0.00	17.52

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CONSUMPTIVE USE Stuttgart, Arkansas



RAINFALL - NET IRRIGATION Stuttgart, Arkansas



USDA

SOIL CONSERVATION SERVICE

MODIFIED BLANEY-CRIDDLE CONSUMPTIVE USE
using a- 1 -HUMID AREA ADJUSTMENT FACTOR

STATION USED- STUTTGART, AR LATITUDE- 34 DEGREES 30 MINUTES
BEGINING OR PLANTING DATE-MAR 20 ENDING OR HARVEST DATE-AUG 20 NET IRRIG APPLIC.= 2 IN.
CROP-SORGHUM -----GSC # 45

MONTH	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
MEAN TEMP	42.9	47.0	54.5	64.8	72.1	79.1	82.7	81.6	75.3	64.6	53.4	45.9	
MEAN PRECIP	3.63	3.49	4.92	4.46	4.99	3.53	2.88	3.21	3.91	2.68	4.05	5.61	47.36
INCHES/MO	0.00	0.00	0.54	2.95	6.37	8.32	7.39	3.09	0.00	0.00	0.00	0.00	
CUM INCHES	0.00	0.00	0.54	3.49	9.87	18.19	25.58	28.67	0.00	0.00	0.00	0.00	28.67
INCHES/DAY	0.00	0.00	0.05	0.10	0.21	0.28	0.24	0.15	0.00	0.00	0.00	0.00	

PEAK USE

0.32 (INCHES/DAY)

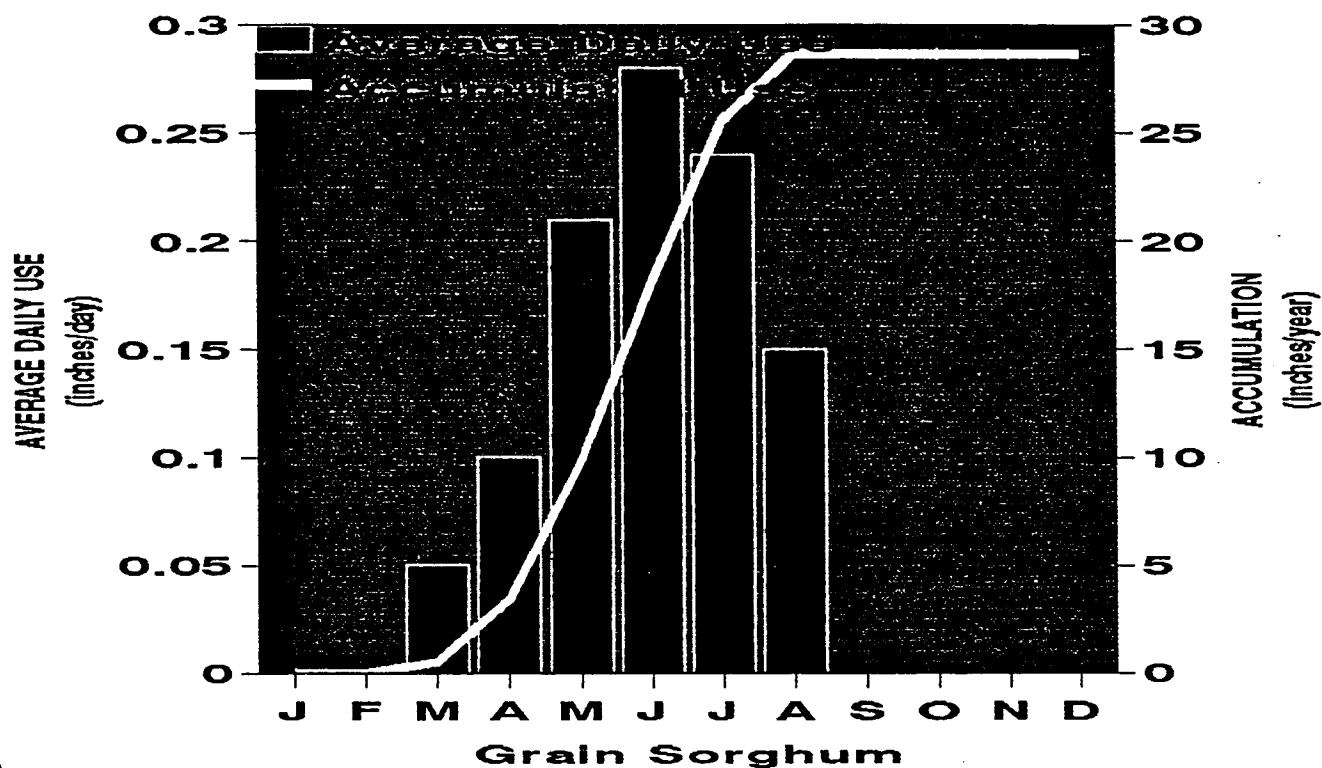
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(THE NET IRRIGATION REQUIREMENT IS COMPUTED LEAVING THE END OF SEASON SOIL MOISTURE AT 50% OF AVAILABLE WATERHOLDING
CAPACITY-THE INITIAL SOIL MOISTURE OF 3.00 INCHES WAS 75% OF AVAILABLE CAPACITY OF 4.00 INCHES)

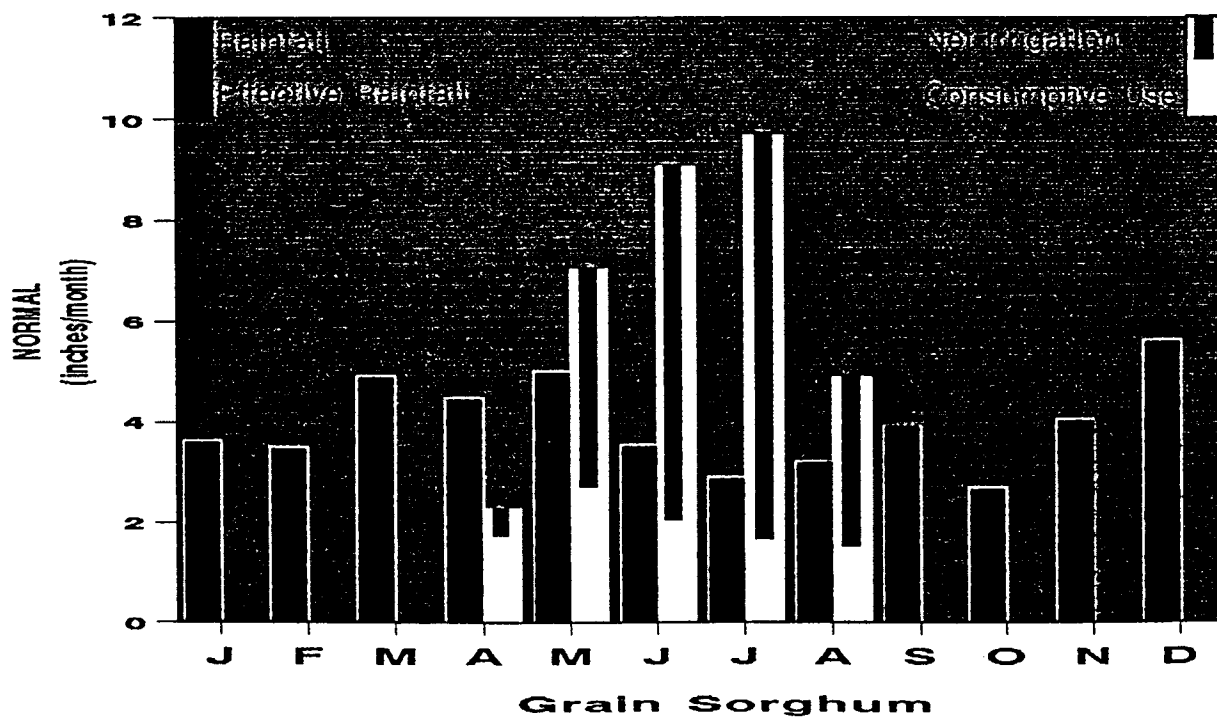
EFFECT RAIN	0.00	0.00	0.54	2.52	3.36	2.77	2.20	1.99	0.00	0.00	0.00	0.00	13.38
NET IRR REQ	0.00	0.00	0.00	0.43	3.02	5.55	5.19	0.10	0.00	0.00	0.00	0.00	14.28

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CONSUMPTIVE USE Stuttgart, Arkansas



RAINFALL - NET IRRIGATION Stuttgart, Arkansas



USDA

SOIL CONSERVATION SERVICE

MODIFIED BLANEY-CRIDDLE CONSUMPTIVE USE
using a- 1 -HUMID AREA ADJUSTMENT FACTOR

STATION USED- STUTTGART, AR LATITUDE- 34 DEGREES 30 MINUTES
BEGINING OR PLANTING DATE-MAY 15 ENDING OR HARVEST DATE-OCT 15 NET IRRIG APPLIC. 2 IN.
CROP-SOYBEANS -----GSC # 46

MONTH	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
MEAN TEMP	42.9	47.0	54.5	64.8	72.1	79.1	82.7	81.6	75.3	64.6	53.4	45.9	
MEAN PRECIP	3.63	3.49	4.92	4.46	4.99	3.53	2.88	3.21	3.91	2.68	4.05	5.61	47.36
INCHES/MO	0.00	0.00	0.00	0.00	1.74	4.73	6.93	8.70	5.38	1.37	0.00	0.00	
CUM INCHES	0.00	0.00	0.00	0.00	1.74	6.47	13.40	22.10	27.48	28.85	0.00	0.00	28.85
INCHES/DAY	0.00	0.00	0.00	0.00	0.11	0.16	0.22	0.28	0.18	0.09	0.00	0.00	

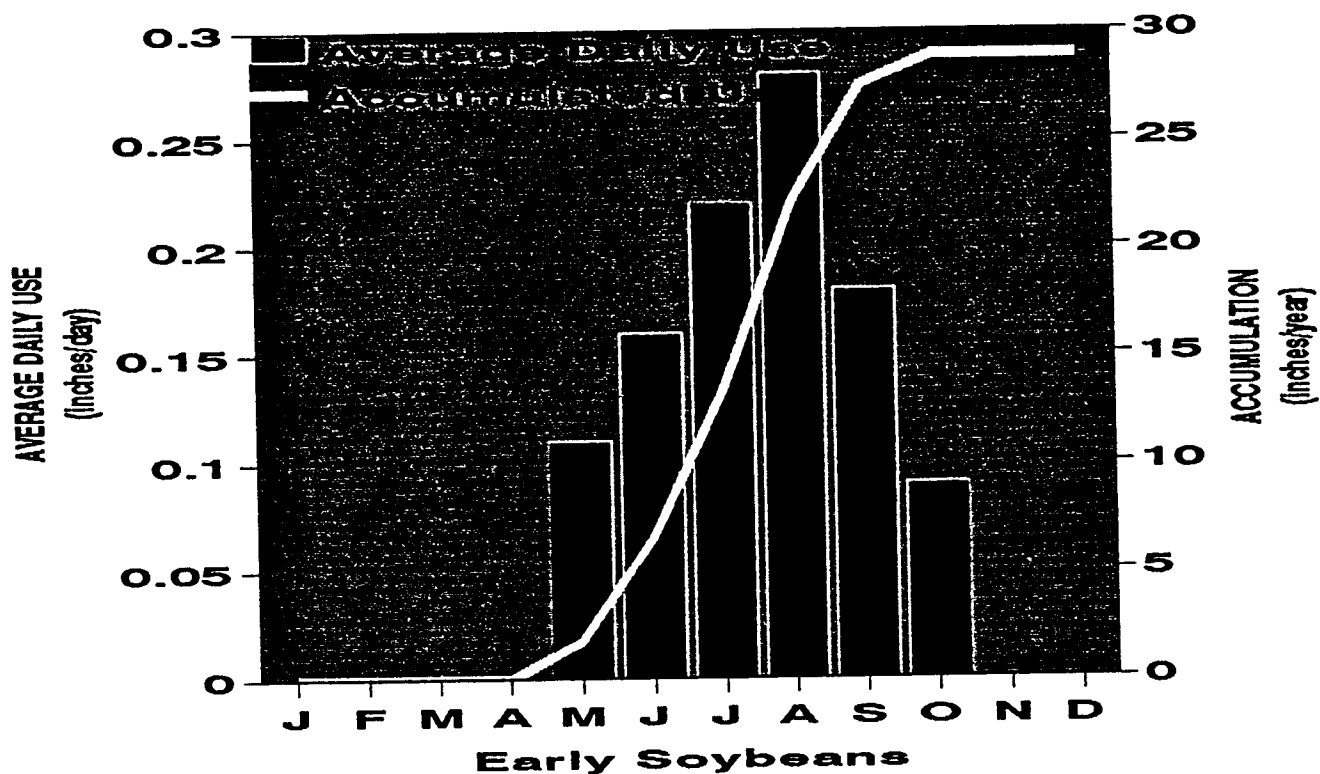
PEAK USE

0.34 (INCHES/DAY)

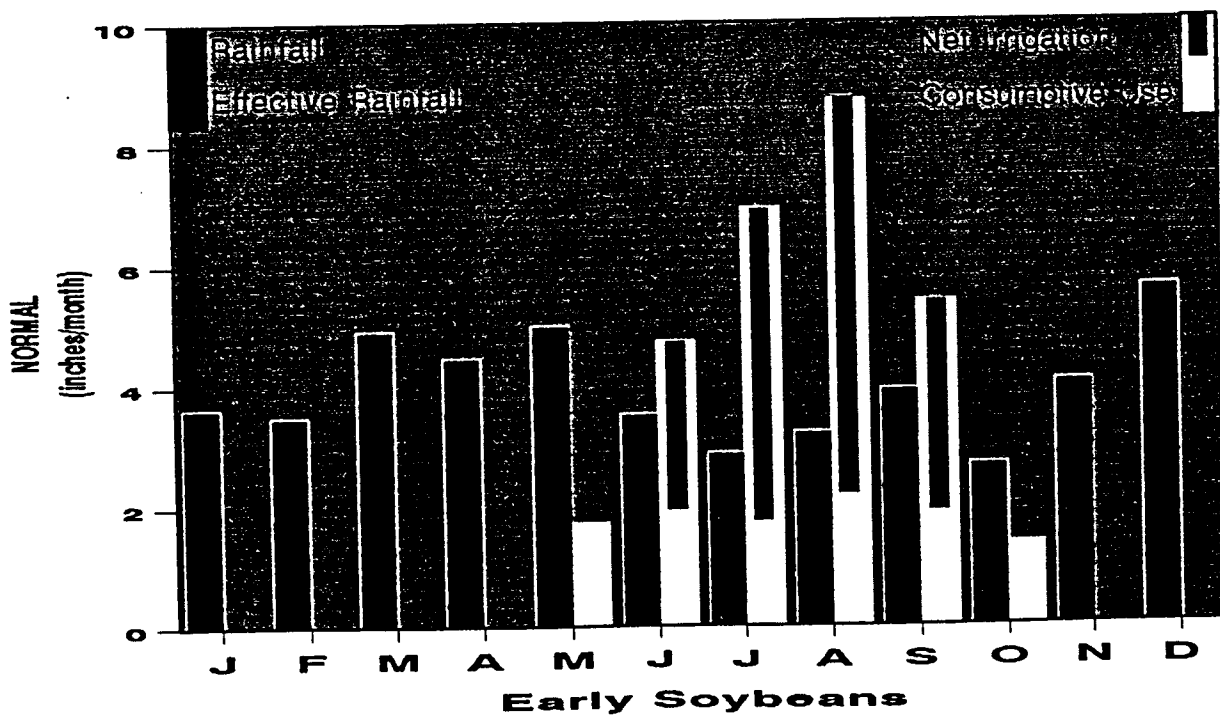
(THE NET IRRIGATION REQUIREMENT IS COMPUTED LEAVING THE END OF SEASON SOIL MOISTURE AT 50% OF AVAILABLE WATERHOLDING
CAPACITY-THE INITIAL SOIL MOISTURE OF 3.00 INCHES WAS 75% OF AVAILABLE CAPACITY OF 4.00 INCHES)

EFFECT RAIN	0.00	0.00	0.00	0.00	1.74	2.27	2.15	2.61	2.57	1.37	0.00	0.00	12.70
NET IRR REQ	0.00	0.00	0.00	0.00	0.00	2.46	4.79	6.10	1.80	0.00	0.00	0.00	15.15

CONSUMPTIVE USE Stuttgart, Arkansas



RAINFALL - NET IRRIGATION Stuttgart, Arkansas



USDA

SOIL CONSERVATION SERVICE

MODIFIED BLANEY-CRIDDLE CONSUMPTIVE USE
using a- 1 -HUMID AREA ADJUSTMENT FACTOR

STATION USED- STUTTGART, AR LATITUDE- 34 DEGREES 30 MINUTES
BEGINING OR PLANTING DATE-JUNE 20 ENDING OR HARVEST DATE-NOV 1 NET IRRIG APPLIC.= 2 IN.
CROP-SOYBEANS -----GSC # 46

MONTH	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
MEAN TEMP	42.9	47.0	54.5	64.8	72.1	79.1	82.7	81.6	75.3	64.6	53.4	45.9	
MEAN PRECIP	3.63	3.49	4.92	4.46	4.99	3.53	2.88	3.21	3.91	2.68	4.05	5.61	47.36
INCHES/MO	0.00	0.00	0.00	0.00	0.00	1.38	5.28	6.59	6.47	3.07	0.06	0.00	
CUM INCHES	0.00	0.00	0.00	0.00	0.00	1.38	6.66	13.26	19.73	22.79	22.85	0.00	22.85
INCHES/DAY	0.00	0.00	0.00	0.00	0.00	0.14	0.17	0.21	0.22	0.10	0.06	0.00	

PEAK USE

0.25 (INCHES/DAY)

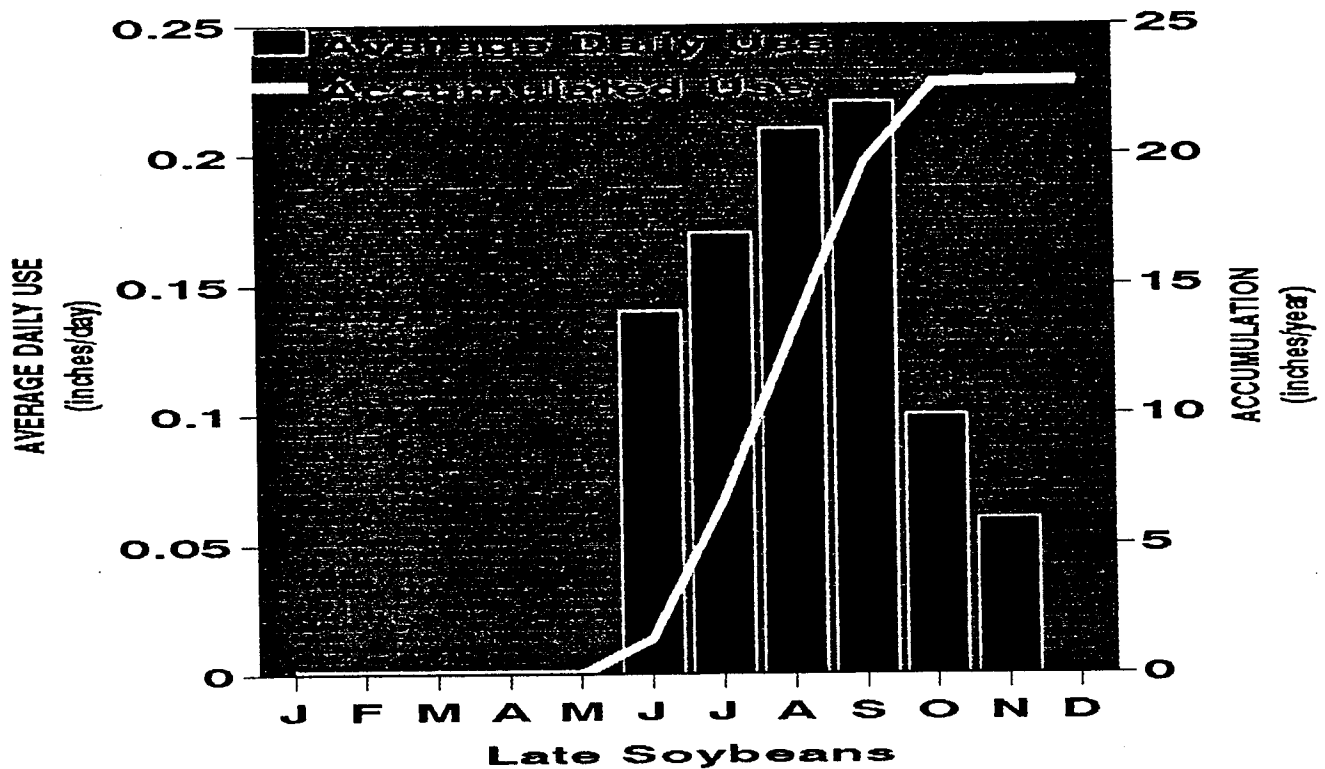
(THE NET IRRIGATION REQUIREMENT IS COMPUTED LEAVING THE END OF SEASON SOIL MOISTURE AT 50% OF AVAILABLE WATERHOLDING
CAPACITY-THE INITIAL SOIL MOISTURE OF 3.00 INCHES WAS 75% OF AVAILABLE CAPACITY OF 4.00 INCHES)

EFFECT RAIN	0.00	0.00	0.00	0.00	0.00	1.38	1.96	2.32	2.73	1.62	0.06	0.00	10.07
NET IRR REQ	0.00	0.00	0.00	0.00	0.00	0.00	3.32	4.28	3.74	0.45	0.00	0.00	11.78

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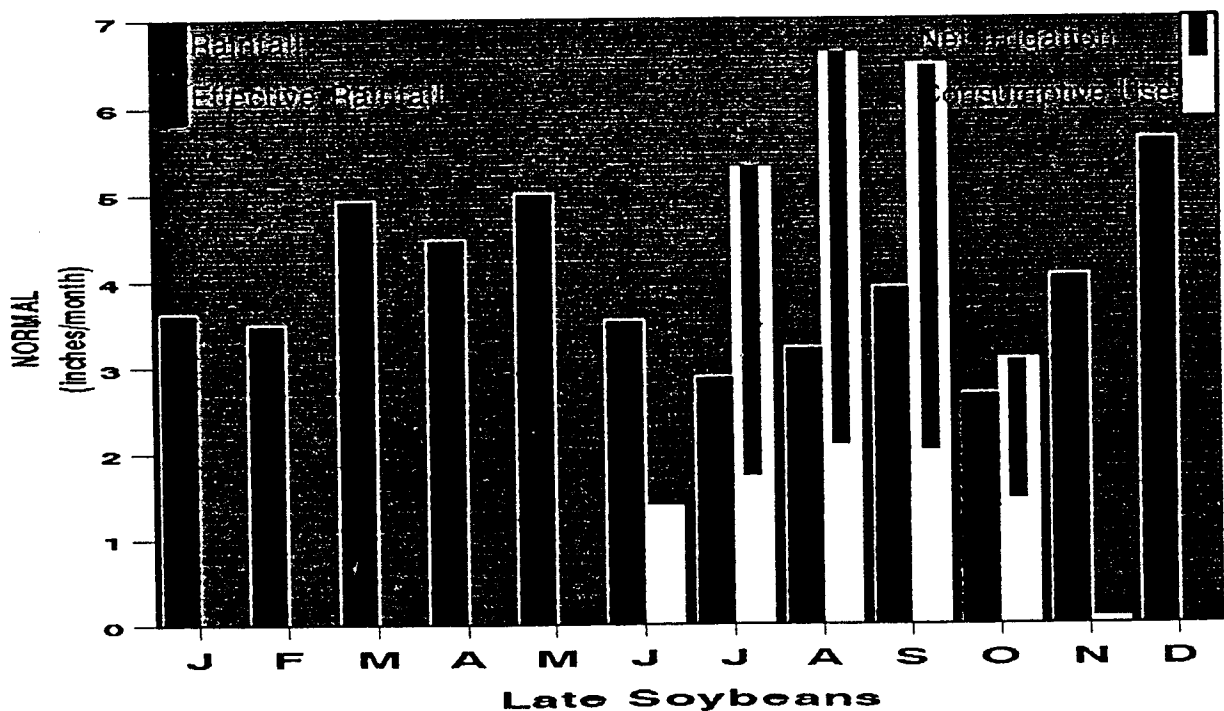
CONSUMPTIVE USE

Stuttgart, Arkansas



RAINFALL - NET IRRIGATION

Stuttgart, Arkansas



USDA

SOIL CONSERVATION SERVICE

MODIFIED BLANEY-CRIDDLE CONSUMPTIVE USE
using a- 1 -HUMID AREA ADJUSTMENT FACTOR

STATION USED- STUTTGART, AR LATITUDE- 34 DEGREES 30 MINUTES
BEGINING OR PLANTING DATE-JAN 1 ENDING OR HARVEST DATE-DEC 31 NET IRRIG APPLIC.= 2 IN.
CROP-SOD-grass -----GSC # 44

MONTH	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
MEAN TEMP	42.9	47.0	54.5	64.8	72.1	79.1	82.7	81.6	75.3	64.6	53.4	45.9	
MEAN PRECIP	3.63	3.49	4.92	4.46	4.99	3.53	2.88	3.21	3.91	2.68	4.05	5.61	47.36
INCHES/MO	0.67	0.86	1.58	2.73	4.07	5.20	5.88	5.23	3.78	2.39	1.25	0.76	
CUM INCHES	0.67	1.53	3.11	5.84	9.91	15.11	20.98	26.22	30.00	32.39	33.64	34.40	34.40
INCHES/DAY	0.02	0.03	0.05	0.09	0.13	0.17	0.19	0.17	0.13	0.08	0.04	0.02	

PEAK USE

0.22 (INCHES/DAY)

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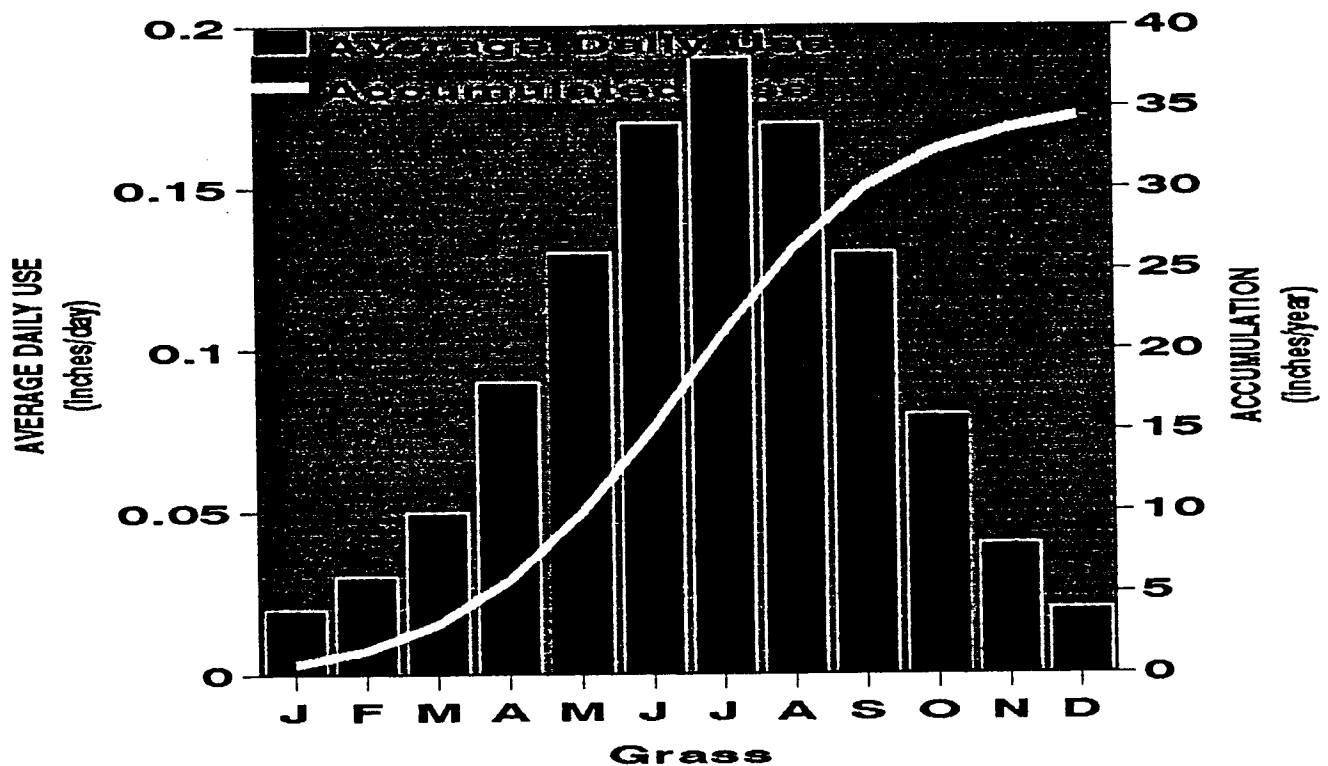
(THE NET IRRIGATION REQUIREMENT IS COMPUTED LEAVING THE END OF SEASON SOIL MOISTURE AT 50% OF AVAILABLE WATERHOLDING
CAPACITY-THE INITIAL SOIL MOISTURE OF 3.00 INCHES WAS 75% OF AVAILABLE CAPACITY OF 4.00 INCHES)

EFFECT RAIN	0.67	0.86	1.58	2.49	2.95	2.33	2.02	2.15	2.35	1.56	1.25	0.76	20.98
NET IRR REQ	0.00	0.00	0.00	0.24	1.12	2.87	3.85	3.09	1.26	0.00	0.00	0.00	12.43

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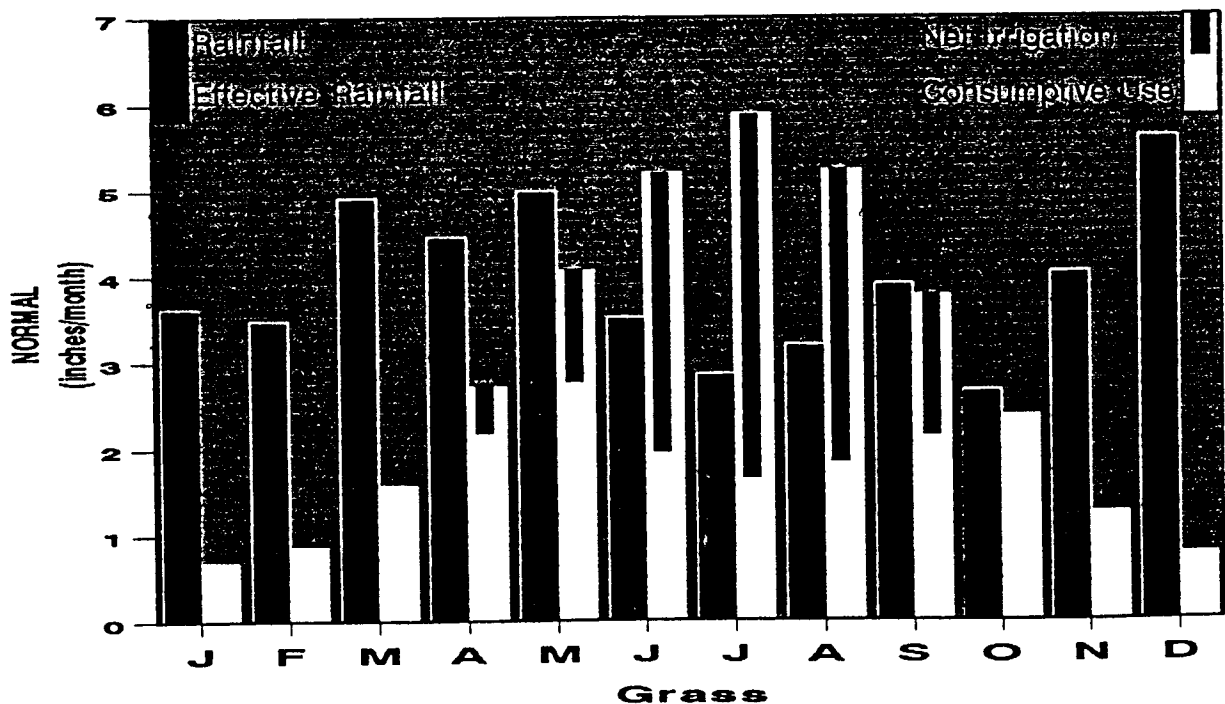
CONSUMPTIVE USE

Stuttgart, Arkansas



RAINFALL - NET IRRIGATION

Stuttgart, Arkansas



USDA

SOIL CONSERVATION SERVICE

MODIFIED BLANEY-CRIDDLE CONSUMPTIVE USE
using a- 1 -HUMID AREA ADJUSTMENT FACTOR

STATION USED- STUTTGART, AR LATITUDE- 34 DEGREES 30 MINUTES
BEGINING OR PLANTING DATE-APR 1 ENDING OR HARVEST DATE-AUG 20 NET IRRIG APPLIC.= .5 IN.
CROP-RICE -----GSC # 43

MONTH	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
MEAN TEMP	42.9	47.0	54.5	64.8	72.1	79.1	82.7	81.6	75.3	64.6	53.4	45.9	
MEAN PRECIP	3.63	3.49	4.92	4.46	4.99	3.53	2.88	3.21	3.91	2.68	4.05	5.61	47.36
INCHES/MO	0.00	0.00	0.00	2.26	7.06	9.04	9.65	4.86	0.00	0.00	0.00	0.00	
CUM INCHES	0.00	0.00	0.00	2.26	9.32	18.36	28.01	32.87	0.00	0.00	0.00	0.00	32.87
INCHES/DAY	0.00	0.00	0.00	0.08	0.23	0.30	0.31	0.24	0.00	0.00	0.00	0.00	
PEAK USE	0.43 (INCHES/DAY)												

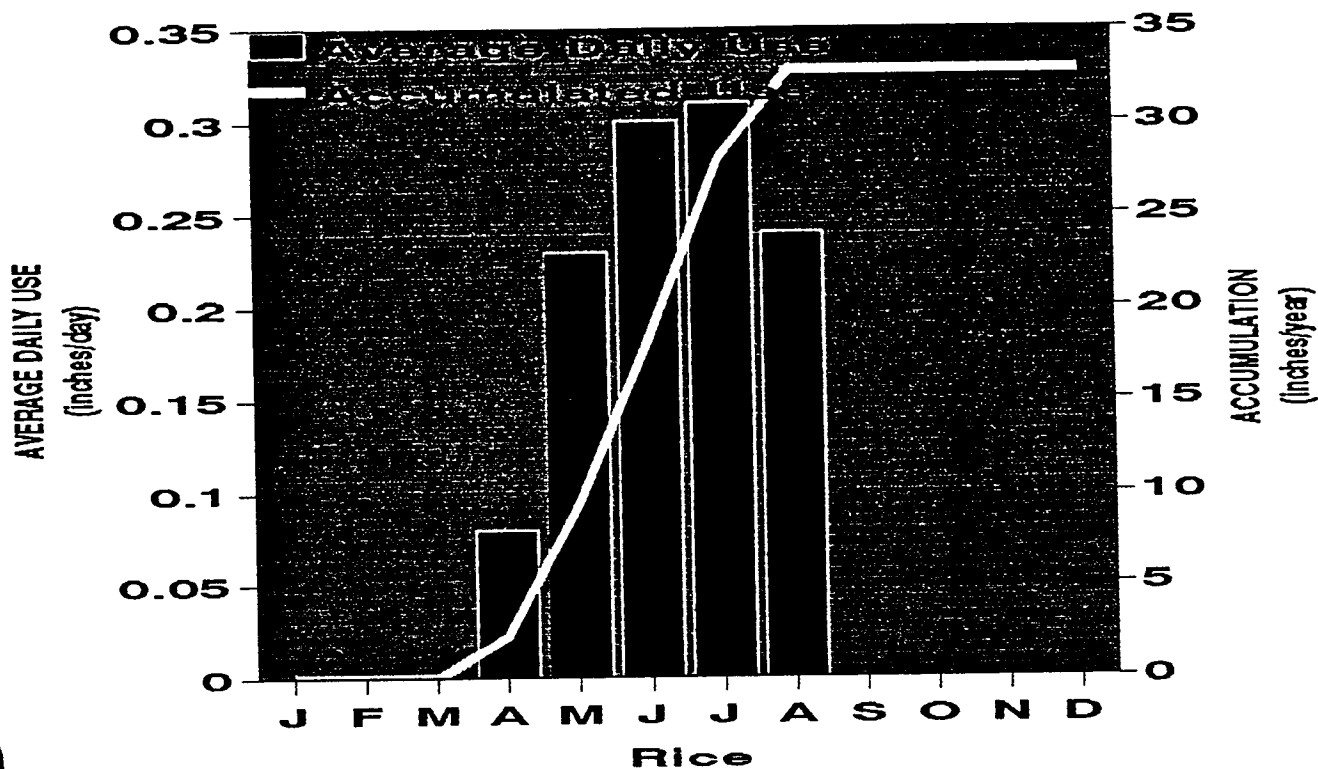
(THE NET IRRIGATION REQUIREMENT IS COMPUTED LEAVING THE END OF SEASON SOIL MOISTURE AT 50% OF AVAILABLE WATERHOLDING CAPACITY-THE INITIAL SOIL MOISTURE OF 3.00 INCHES WAS 75% OF AVAILABLE CAPACITY OF 4.00 INCHES)

EFFECT RAIN	0.00	0.00	0.00	1.83	2.52	2.08	1.80	1.59	0.00	0.00	0.00	0.00	9.82
NET IRR REQ	0.00	0.00	0.00	0.43	4.54	6.96	7.84	2.27	0.00	0.00	0.00	0.00	22.05

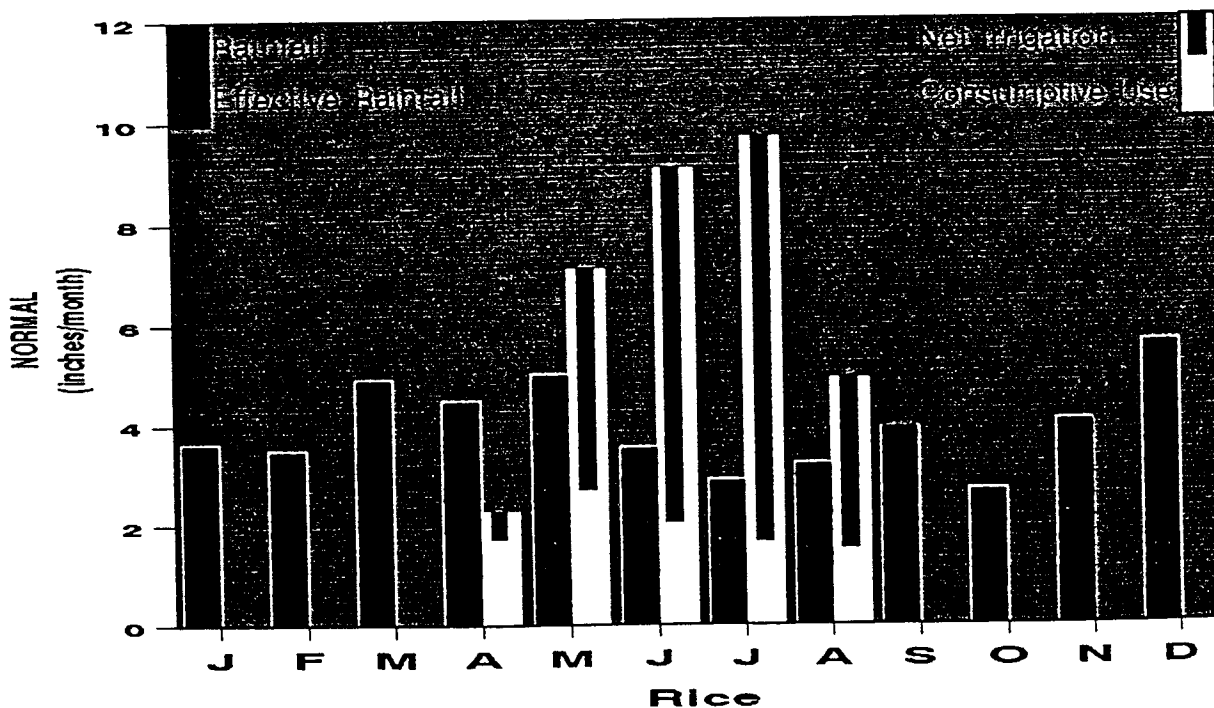
$$Q_{RICE} = \left(\frac{.43 \text{ IN}}{\text{DAY}} \right) \left(\frac{\text{FT}}{12 \text{ IN}} \right) (43,560 \text{ FT}^2/\text{AC}) \left(\frac{7.48 \text{ GAL}}{\text{FT}^3} \right) \left(\frac{\text{DAY}}{20 \text{ HRS}} \right) \left(\frac{\text{HR}}{60 \text{ MIN}} \right) \left(\frac{1}{.707 \text{ EFF}} \right)$$

$$= 13.9 \text{ GPM/AC (PEAK)}$$

CONSUMPTIVE USE Stuttgart, Arkansas



RAINFALL - NET IRRIGATION Stuttgart, Arkansas



APPENDIX D

CLIMATIC DATA

RAINFALL DATA 1965 TO 1981

DRY YEAR

Avg year run

Select Year to run 1969

day	Month	avg/day	10dy avg	30dy avg	day	Month	daily	10 day	30 day
1	Jan 1	0.08			1	Jan 1	0.00		
2		0.14			2		0.00		
3		0.20			3		0.10		
4		0.17			4		TRACE		
5		0.04			5		0.00		
6		0.15			6		0.00		
7		0.16			7		0.00		
8		0.05			8		TRACE		
9		0.15			9		0.00		
10		0.28	1.41		10		0.00	0.10	
11		0.25			11		0.00		
12		0.06			12		0.00		
13		0.01			13		0.00		
14		0.16			14		0.00		
15		0.00			15		0.00		
16		0.06			16		TRACE		
17		0.10			17		0.37		
18		0.04			18		0.31		
19		0.04			19		0.02		
20		0.27	1.00		20		TRACE	0.70	
21		0.21			21		TRACE		
22		0.10			22		0.15		
23		0.15			23		0.13		
24		0.19			24		0.00		
25		0.12			25		0.00		
26		0.09			26		0.00		
27		0.10			27		0.06		
28		0.12			28		0.02		
29		0.03			29		0.12		
30		0.13	1.22	3.63	30		1.64	2.12	2.92
31		0.06			31		0.39		
32	Feb 1	0.25			32	Feb 1	1.13		
33		0.22			33		1.30		
34		0.08			34		TRACE		
35		0.04			35		0.00		
36		0.06			36		0.00		
37		0.09			37		0.22		
38		0.06			38		0.00		
39		0.15			39		0.11		
40		0.14	1.15		40		0.00	3.15	
41		0.42			41		0.00		
42		0.15			42		0.00		
43		0.17			43		0.00		
44		0.15			44		0.00		
45		0.01			45		0.00		
46		0.12			46		0.82		
47		0.15			47		0.22		
48		0.01			48		0.03		
49		0.09			49		0.00		
50		0.05	1.33		50		0.00	1.07	
51		0.12			51		0.00		
52		0.08			52		0.01		
53		0.20			53		0.67		
54		0.18			54		0.01		

Day	Month	Avg/day	Avg/10day	Avg/30day	Day	Month	Daily	Avg10day	Avg30day
55		0.09			55		0.00		
56		0.11			56		0.00		
57		0.02			57		0.00		
58		0.04			58		0.00		
59		0.08			59		0.01		
60		0.09	1.01	3.49	60			0.70	4.92
61	March 1	0.11			61	March 1	0.00		
62		0.08			62		0.00		
63		0.19			63		0.00		
64		0.29			64		0.00		
65		0.07			65		0.00		
66		0.11			66		0.39		
67		0.11			67		0.01		
68		0.13			68		0.04		
69		0.08			69	TRACE			
70		0.20	1.37		70		0.00	0.44	
71		0.11			71		0.00		
72		0.46			72		0.00		
73		0.21			73		0.00		
74		0.10			74		0.00		
75		0.03			75		0.00		
76		0.17			76		0.00		
77		0.27			77		0.00		
78		0.08			78		0.54		
79		0.05			79		0.07		
80		0.07	1.56		80		0.00	0.61	
81		0.31			81		0.00		
82		0.13			82		0.00		
83		0.12			83		0.27		
84		0.24			84		1.94		
85		0.21			85		0.00		
86		0.21			86		0.00		
87		0.07			87		0.00		
88		0.21			88		0.00		
89		0.27			89		0.18		
90		0.22	1.99	4.92	90		0.04	2.43	3.48
91		0.12			91	TRACE			
92	April 1	0.01			92	April 1	0.00		
93		0.28			93		0.00		
94		0.10			94		0.00		
95		0.17			95		0.00		
96		0.04			96		0.30		
97		0.00			97		0.01		
98		0.02			98		0.00		
99		0.05			99		0.00		
100		0.10	0.89		100	TRACE		0.31	
101		0.06			101		0.88		
102		0.10			102		0.00		
103		0.21			103		0.00		
104		0.12			104		0.14		
105		0.20			105		0.45		
106		0.00			106		0.00		
107		0.10			107		0.00		

Day	Month	Avg/day	Avg/10day	Avg/30day	Day	Month	Daily	Avg10day	Avg30day
108		0.11			108		0.00		
109		0.24			109		0.42		
110		0.12	1.27		110		TRACE	1.89	
111		0.29			111		0.00		
112		0.28			112		0.00		
113		0.07			113		0.00		
114		0.57			114		0.00		
115		0.24			115		0.00		
116		0.24			116		0.00		
117		0.36			117		0.00		
118		0.11			118		0.00		
119		0.06			119		0.60		
120		0.10	2.30	4.46	120		0.00	0.60	2.80
121		0.09			121		0.00		
122	May 1	0.35			122	May 1	0.00		
123		0.26			123		0.00		
124		0.23			124		0.00		
125		0.30			125		0.00		
126		0.09			126		0.35		
127		0.21			127		TRACE		
128		0.20			128		TRACE		
129		0.03			129		0.05		
130		0.13	1.89		130		0.58	0.98	
131		0.13			131		0.00		
132		0.08			132		0.00		
133		0.21			133		0.00		
134		0.22			134		0.02		
135		0.36			135		0.00		
136		0.33			136		0.00		
137		0.15			137		0.00		
138		0.28			138		0.00		
139		0.13			139		0.90		
140		0.02	1.90		140		0.26	1.18	
141		0.14			141		0.00		
142		0.03			142		0.00		
143		0.20			143		0.00		
144		0.09			144		0.00		
145		0.03			145		0.04		
146		0.08			146		0.03		
147		0.19			147		0.00		
148		0.17			148		0.00		
149		0.09			149		0.00		
150		0.17	1.20	4.99	150		0.00	0.07	2.23
151		0.10			151		0.06		
152		0.06			152		0.00		
153	June 1	0.35			153	June 1	0.00		
154		0.30			154		0.57		
155		0.28			155		0.00		
156		0.08			156		TRACE		
157		0.03			157		0.00		
158		0.17			158		0.00		
159		0.30			159		0.00		
160		0.11	1.78		160		0.00	0.63	

Day	Month	Avg/day	Avg/10day	Avg/30day	Day	Month	Daily	Avg10day	Avg30day
161		0.05			161		0.00		
162		0.19			162		0.83		
163		0.00			163		0.00		
164		0.04			164		0.00		
165		0.01			165		0.00		
166		0.07			166		0.17		
167		0.14			167		0.00		
168		0.13			168		0.00		
169		0.07			169		0.00		
170		0.05	0.74		170		0.00	1.00	
171		0.18			171		0.01		
172		0.10			172		0.00		
173		0.07			173		0.05		
174		0.15			174		0.95		
175		0.02			175		0.00		
176		0.09			176		0.33		
177		0.12			177		0.00		
178		0.12			178		0.00		
179		0.05			179		0.00		
180		0.12	1.01	3.53	180		0.00	1.34	2.97
181		0.08			181		0.00		
182		0.19			182		0.68		
183	July 1	0.06			183	July 1	0.00		
184		0.18			184		0.00		
185		0.07			185		0.28		
186		0.05			186		0.00		
187		0.05			187		0.00		
188		0.01			188		0.00		
189		0.04			189		0.00		
190		0.11	0.84		190		0.00	0.96	
191		0.15			191		0.00		
192		0.27			192		0.00		
193		0.10			193		0.00		
194		0.06			194		0.00		
195		0.04			195		0.00		
196		0.00			196		0.00		
197		0.02			197		0.00		
198		0.13			198		0.00		
199		0.11			199		0.00		
200		0.01	0.91		200		0.00	0.00	
201		0.03			201		0.00		
202		0.08			202		0.00		
203		0.08			203		0.00		
204		0.02			204		0.00		
205		0.04			205		0.15		
206		0.14			206		0.03		
207		0.11			207		0.68		
208		0.38			208		0.00		
209		0.06			209		0.06		
210		0.19	1.13	2.88	210		0.82	1.74	2.70
211		0.24			211		0.00		
212		0.26			212		0.00		
213		0.04			213		0.00		

Day Month	Avg/day	Avg/10day	Avg/30day	Day Month	Daily	Avg10day	Avg30day
214 Aug 1	0.05			214 Aug 1	0.00		
215	0.16			215	0.00		
216	0.26			216	0.00		
217	0.06			217	0.00		
218	0.04			218	0.00		
219	0.02			219	0.00		
220	0.08	1.23		220	0.00	0.00	
221	0.14			221	0.00		
222	0.01			222	0.00		
223	0.39			223	0.00		
224	0.11			224	0.00		
225	0.05			225	0.00		
226	0.03			226	0.00		
227	0.14			227	0.00		
228	0.01			228	0.00		
229	0.06			229	TRACE		
230	0.21	1.14		230	2.55	2.55	
231	0.14			231	0.44		
232	0.08			232	0.67		
233	0.01			233	0.00		
234	0.01			234	0.00		
235	0.13			235	0.30		
236	0.35			236	0.00		
237	0.05			237	0.00		
238	0.04			238	0.00		
239	0.01			239	0.00		
240	0.03	0.85	3.21	240	0.00	1.41	3.96
241	0.00			241	0.00		
242	0.23			242	0.00		
243	0.14			243	0.00		
244	0.10			244	0.00		
245 Sept 1	0.07			245 Sept 1	TRACE		
246	0.11			246	0.00		
247	0.14			247	0.04		
248	0.10			248	0.68		
249	0.14			249	0.03		
250	0.11	1.15		250	0.00	0.75	
251	0.14			251	0.00		
252	0.05			252	0.00		
253	0.15			253	0.00		
254	0.01			254	0.00		
255	0.35			255	0.00		
256	0.12			256	0.00		
257	0.05			257	0.00		
258	0.33			258	0.00		
259	0.35			259	0.00		
260	0.19	1.74		260	0.00	0.00	
261	0.16			261	0.00		
262	0.10			262	0.00		
263	0.08			263	0.00		
264	0.06			264	0.03		
265	0.25			265	TRACE		
266	0.06			266	TRACE		

Day	Month	Avg/day	Avg/10day	Avg/30day	Day	Month	Daily	Avg10day	Avg30day
267		0.11			267		0.00		
268		0.07			268		TRACE		
269		0.08			269		0.00		
270		0.05	1.02	3.91	270		0.00	0.03	0.78
271		0.05			271		0.00		
272		0.21			272		0.00		
273		0.16			273		0.00		
274		0.10			274		0.00		
275	Oct 1	0.07			275	Oct 1	0.00		
276		0.00			276		0.00		
277		0.01			277		0.00		
278		0.05			278		0.00		
279		0.07			279		0.00		
280		0.16	0.88		280		0.00	0.60	
281		0.06			281		0.79		
282		0.17			282		0.00		
283		0.06			283		0.00		
284		0.02			284		0.00		
285		0.00			285		TRACE		
286		0.07			286		0.00		
287		0.09			287		0.15		
288		0.16			288		0.05		
289		0.15			289		0.00		
290		0.09	0.86		290		0.00	0.99	
291		0.06			291		0.00		
292		0.26			292		0.00		
293		0.05			293		0.00		
294		0.04			294		0.00		
295		0.00			295		0.00		
296		0.04			296		0.00		
297		0.14			297		0.00		
298		0.05			298		0.00		
299		0.21			299		0.00		
300		0.07	0.94	2.68	300		0.01	0.01	1.00
301		0.19			301		TRACE		
302		0.07			302		0.00		
303		0.18			303		0.00		
304		0.09			304		0.01		
305		0.25			305		0.66		
306	Nov 1	0.04			306	Nov 1	0.02		
307		0.20			307		0.00		
308		0.11			308		0.07		
309		0.08			309		0.04		
310		0.12	1.32		310		0.00	0.80	
311		0.00			311		0.00		
312		0.38			312		0.00		
313		0.04			313		0.01		
314		0.12			314		0.00		
315		0.09			315		0.00		
316		0.09			316		0.00		
317		0.03			317		0.22		
318		0.04			318		0.00		
319		0.15			319		0.00		

Day	Month	Avg/day	Avg/10day	Avg/30day	Day	Month	Daily	Avg10day	Avg30day
320		0.15	1.09		320		0.00	0.23	
321		0.17			321		0.00		
322		0.23			322		0.36		
323		0.21			323		2.18		
324		0.29			324		1.13		
325		0.06			325		0.00		
326		0.16			326		0.00		
327		0.21			327		0.00		
328		0.12			328		0.00		
329		0.08			329		0.00		
330		0.12	1.65	4.05	330		0.00	3.67	4.70
331		0.11			331		0.00		
332		0.27			332		TRACE		
333		0.23			333		0.15		
334		0.17			334		0.00		
335		0.20			335		0.00		
336	Dec 1	0.08			336	Dec 1	0.00		
337		0.09			337		0.00		
338		0.16			338		0.00		
339		0.26			339		0.00		
340		0.01	1.58		340		0.00	0.15	
341		0.21			341		1.09		
342		0.20			342		0.53		
343		0.19			343		0.00		
344		0.38			344		0.00		
345		0.21			345		0.00		
346		0.13			346		0.01		
347		0.19			347		0.00		
348		0.26			348		0.00		
349		0.09			349		0.00		
350		0.15	2.01		350		0.00	1.63	
351		0.11			351		0.00		
352		0.05			352		0.00		
353		0.05			353		0.00		
354		0.03			354		0.05		
355		0.10			355		0.00		
356		0.25			356		0.94		
357		0.13			357		0.12		
358		0.12			358		0.00		
359		0.18			359		0.00		
360		0.18	1.20	4.79	360		0.66	1.77	3.55
361		0.06			361		0.00		
362		0.06			362		0.00		
363		0.17			363		0.06		
364		0.20			364		2.66		
365		0.16			365		0.81		
366		0.16	0.82	0.82	366		0.24	3.77	3.77
367					367				
Totals		47.36	47.36	47.36	Totals		39.78	39.78	39.78
Avg crop season		0.12	1.23	3.70	Avg crop season		0.08	0.84	2.53

Day Month	Avg/day	Avg/10day	Avg/30day	Day Month	Daily	Avg10day	Avg30day
Sum crop season	18.95	18.52	18.52	Sum crop season	12.64	12.64	12.64
Sum off-season	28.41	28.84	28.84	Sum off-season	27.14	27.14	27.14
Summary avg year	1 day	10 day	30 day	Summary 1969	1 day	10 day	30 day

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AVG 1965 TO 1981 PAN EVAPORATION DATA

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AVG 1965 TO 1981 PAN EVAPORATION DATA

Month	Day	Avg/day	10 DY AV	30 DY AV
Jan 1	1	0.05		
	2	0.10		
	3	0.08		
	4	0.00		
	5	0.07		
	6	0.05		
	7	0.02		
	8	0.05		
	9	0.06		
	10	0.19	0.66	
	11	0.10		
	12	0.04		
	13	0.03		
	14	0.02		
	15	0.02		
	16	0.01		
	17	0.11		
	18	0.04		
	19	0.14		
	20	0.04	0.54	
	21	0.10		
	22	0.08		
	23	0.07		
	24	0.10		
	25	0.11		
	26	0.08		
	27	0.06		
	28	0.09		
	29	0.07		
Feb 1	30	0.07	0.81	2.01
	31	0.12		
	32	0.08		
	33	0.09		
	34	0.03		
	35	0.02		
	36	0.14		
	37	0.13		
	38	0.09		
	39	0.11		
	40	0.05	0.86	
	41	0.06		
	42	0.11		
	43	0.09		
	44	0.04		
	45	0.09		
	46	0.07		
	47	0.14		
	48	0.04		
	49	0.07		
	50	0.18	0.88	

Month	Day	Avg/day	10 day	30 day
	51	0.09		
	52	0.11		
	53	0.09		
	54	0.16		
	55	0.13		
	56	0.10		
	57	0.11		
	58	0.11		
	59	0.13		
Mar 1	60	0.20	1.23	2.97
	61	0.07		
	62	0.11		
	63	0.07		
	64	0.09		
	65	0.14		
	66	0.12		
	67	0.10		
	68	0.10		
	69	0.20		
	70	0.12	1.13	
	71	0.13		
	72	0.18		
	73	0.15		
	74	0.13		
	75	0.14		
	76	0.17		
	77	0.16		
	78	0.16		
	79	0.15		
	80	0.15	1.52	
	81	0.18		
	82	0.15		
	83	0.17		
	84	0.15		
	85	0.16		
	86	0.16		
	87	0.11		
	88	0.15		
	89	0.17		
Apr 1	90	0.14	1.54	4.19
	91	0.18		
	92	0.20		
	93	0.22		
	94	0.21		
	95	0.22		
	96	0.18		
	97	0.21		
	98	0.20		
	99	0.21		
	100	0.20	2.01	
	101	0.20		
	102	0.20		
	103	0.21		
	104	0.22		
	105	0.18		

Month	Day	Avg/day	10 day	30 day
	107	0.23		
	108	0.23		
	109	0.22		
	110	0.20	2.06	
	111	0.21		
	112	0.21		
	113	0.17		
	114	0.24		
	115	0.21		
	116	0.23		
	117	0.20		
	118	0.22		
	119	0.21		
May 1	120	0.22	2.12	6.19
	121	0.18		
	122	0.22		
	123	0.17		
	124	0.22		
	125	0.21		
	126	0.19		
	127	0.22		
	128	0.20		
	129	0.21		
	130	0.24	2.07	
	131	0.22		
	132	0.23		
	133	0.24		
	134	0.21		
	135	0.25		
	136	0.30		
	137	0.24		
	138	0.24		
	139	0.19		
	140	0.25	2.37	
	141	0.26		
	142	0.27		
	143	0.22		
	144	0.25		
	145	0.26		
	146	0.26		
	147	0.26		
	148	0.24		
	149	0.24		
Jun 1	150	0.24	2.51	6.94
	151	0.25		
	152	0.27		
	153	0.27		
	154	0.26		
	155	0.26		
	156	0.28		
	157	0.26		
	158	0.24		
	159	0.31		
	160	0.26	2.66	
	161	0.29		

Month	Day	Avg/day	10 day	30 day
	163	0.28		
	164	0.31		
	165	0.29		
	166	0.30		
	167	0.31		
	168	0.28		
	169	0.29		
	170	0.28	2.87	
	171	0.28		
	172	0.27		
	173	0.26		
	174	0.31		
	175	0.29		
	176	0.26		
	177	0.29		
	178	0.30		
	179	0.27		
Jul 1	180	0.30	2.82	8.35
	181	0.27		
	182	0.33		
	183	0.29		
	184	0.25		
	185	0.28		
	186	0.31		
	187	0.29		
	188	0.27		
	189	0.28		
	190	0.27	2.84	
	191	0.28		
	192	0.28		
	193	0.31		
	194	0.29		
	195	0.30		
	196	0.30		
	197	0.30		
	198	0.30		
	199	0.24		
	200	0.29	2.88	
	201	0.29		
	202	0.27		
	203	0.26		
	204	0.24		
	205	0.26		
	206	0.25		
	207	0.28		
	208	0.25		
	209	0.23		
Aug 1	210	0.26	2.59	8.31
	211	0.24		
	212	0.26		
	213	0.24		
	214	0.26		
	215	0.23		
	216	0.25		
	217	0.24		

Month	Day	Avg/day	10 day	30 day
	219	0.26		
	220	0.26	2.47	
	221	0.23		
	222	0.25		
	223	0.26		
	224	0.23		
	225	0.24		
	226	0.23		
	227	0.22		
	228	0.23		
	229	0.25		
	230	0.25	2.39	
	231	0.23		
	232	0.23		
	233	0.24		
	234	0.24		
	235	0.24		
	236	0.27		
	237	0.21		
	238	0.23		
	239	0.23		
Sep 1	240	0.25	2.36	7.22
	241	0.24		
	242	0.22		
	243	0.20		
	244	0.23		
	245	0.21		
	246	0.19		
	247	0.17		
	248	0.16		
	249	0.19		
	250	0.18	1.98	
	251	0.20		
	252	0.20		
	253	0.21		
	254	0.20		
	255	0.18		
	256	0.17		
	257	0.18		
	258	0.20		
	259	0.20		
	260	0.18	1.93	
	261	0.18		
	262	0.16		
	263	0.16		
	264	0.15		
	265	0.18		
	266	0.17		
	267	0.16		
	268	0.17		
	269	0.15		
Oct 1	270	0.15	1.65	5.57
	271	0.15		
	272	0.14		
	273	0.15		
	274	0.14		

Month	Day	Avg/day	10 day	30 day
	275	0.18		
	276	0.18		
	277	0.19		
	278	0.19		
	279	0.17		
	280	0.17	1.68	
	281	0.14		
	282	0.13		
	283	0.14		
	284	0.15		
	285	0.17		
	286	0.16		
	287	0.17		
	288	0.12		
	289	0.17		
	290	0.15	1.51	
	291	0.11		
	292	0.13		
	293	0.14		
	294	0.13		
	295	0.12		
	296	0.16		
	297	0.13		
	298	0.14		
	299	0.13		
Nov 1	300	0.09	1.28	4.47
	301	0.12		
	302	0.12		
	303	0.09		
	304	0.10		
	305	0.12		
	306	0.11		
	307	0.11		
	308	0.10		
	309	0.09		
	310	0.09	1.05	
	311	0.09		
	312	0.09		
	313	0.08		
	314	0.13		
	315	0.12		
	316	0.08		
	317	0.08		
	318	0.11		
	319	0.10		
	320	0.07	0.95	
	321	0.13		
	322	0.09		
	323	0.10		
	324	0.07		
	325	0.10		
	326	0.13		
	327	0.07		
	328	0.06		
	329	0.06		

Month	Day	Avg/day	10 day	30 day
	331	0.11		
	332	0.09		
	333	0.09		
	334	0.06		
	335	0.07		
	336	0.05		
	337	0.11		
	338	0.07		
	339	0.03		
	340	0.10	0.81	
	341	0.08		
	342	0.05		
	343	0.05		
	344	0.03		
	345	0.12		
	346	0.07		
	347	0.08		
	348	0.10		
	349	0.05		
	350	0.07	0.71	
	351	0.05		
	352	0.04		
	353	0.09		
	354	0.09		
	355	0.05		
	356	0.06		
	357	0.08		
	358	0.07		
	359	0.05		
	360	0.09	0.67	2.18
	361	0.06		
	362	0.03		
	363	0.08		
	364	0.04		
	365	0.09		
	366	0.06	0.36	0.36
AVG				
55.11	TOTALS	61.63	61.63	61.63
	CROP SEA	36.38	36.38	36.38
	OFFR-SEA	25.25	25.25	25.25

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AVG DAILY TEMP 1965 TO 1981

AVG YEAR DATA

DAY MONTH DAILY 10 DAY 30 DAY

1.00	Jan 1	39.88		
2.00		38.44		
3.00		37.76		
4.00		35.24		
5.00		33.47		
6.00		35.56		
7.00		36.97		
8.00		35.24		
9.00		33.76		
10.00		33.38	35.97	
11.00		34.68		
12.00		34.50		
13.00		35.03		
14.00		37.56		
15.00		36.71		
16.00		37.68		
17.00		37.68		
18.00		38.91		
19.00		38.65		
20.00		40.44	12.39	
21.00		39.21		
		41.82		
		43.41		
24.00		43.65		
25.00		43.21		
26.00		43.41		
27.00		40.38		
28.00		42.26		
29.00		41.63		
30.00		39.29	41.83	38.33
31.00		38.76		
32.00	Feb 1	39.97		
33.00		39.12		
34.00		36.71		
35.00		36.97		
36.00		41.50		
37.00		41.09		
38.00		39.03		
39.00		36.38		
40.00		36.50	38.60	
41.00		37.29		
42.00		41.94		
43.00		41.68		
44.00		40.35		
45.00		42.85		
46.00		45.91		
47.00		43.68		
48.00		39.94		

AVG DAILY TEMP 1965 TO 1981

SPECIFIC YEAR DATA 1969.00

DAY MONTH DAILY 10 DAY 30 DAY

1.00	Jan 1	33.85		
2.00		34.71		
3.00		38.09		
4.00		29.88		
5.00		29.21		
6.00		32.09		
7.00		37.32		
8.00		37.71		
9.00		37.41		
10.00		31.79	34.21	
11.00		31.79		
12.00		31.97		
13.00		33.03		
14.00		35.82		
15.00		38.74		
16.00		41.85		
17.00		47.65		
18.00		51.00		
19.00		42.12		
20.00		42.56	13.22	
21.00		41.62		
22.00		49.06		
23.00		51.32		
24.00		41.85		
25.00		39.24		
26.00		39.79		
27.00		39.56		
28.00		43.56		
29.00		54.09		
30.00		52.94	45.30	39.72
31.00		42.94		
32.00	Feb 1	43.12		
33.00		44.62		
34.00		39.41		
35.00		37.68		
36.00		41.68		
37.00		44.06		
38.00		43.21		
39.00		43.91		
40.00		40.76	42.14	
41.00		38.12		
42.00		42.71		
43.00		43.97		
44.00		39.38		
45.00		41.29		
46.00		45.44		
47.00		40.97		
48.00		38.74		

R

DAY MONTH DAILY 10 DAY 30 DAY

DAY MONTH DAILY 10 DAY 30 DAY

49.00	41.53		
50.00	43.03	41.82	
51.00	43.76		
52.00	46.00		
53.00	45.97		
54.00	43.74		
55.00	44.79		
56.00	44.03		
57.00	45.00		
58.00	45.03		
59.00	48.85		
60.00	52.50	45.97	42.13
61.00 March 1	48.74		
62.00	48.97		
63.00	47.68		
64.00	46.26		
65.00	47.21		
66.00	45.68		
67.00	48.06		
68.00	49.38		
69.00	49.06		
70.00	51.04	48.21	
71.00	52.75		
72.00	52.56		
73.00	53.00		
74.00	52.35		

49.00	39.76		
50.00	40.71	41.11	
51.00	43.53		
52.00	47.29		
53.00	50.56		
54.00	43.76		
55.00	44.47		
56.00	27.28		
57.00	46.03		
58.00	48.88		
59.00	49.24		
60.00	34.00	43.50	42.25
61.00 March 1	48.00		
62.00	45.65		
63.00	44.76		
64.00	43.35		
65.00	45.94		
66.00	44.65		
67.00	42.71		
68.00	44.97		
69.00	42.00		
70.00	42.72	44.47	
71.00	44.22		
72.00	43.24		
73.00	45.34		
74.00	47.21		

DAY MONTH DAILY 10 DAY 30 DAY

DAY MONTH DAILY 10 DAY 30 DAY

75.00	52.53		
76.00	52.24		
77.00	51.21		
78.00	53.35		
79.00	52.59		
80.00	55.09	52.77	
81.00	53.82		
82.00	51.38		
83.00	53.53		
84.00	52.91		
85.00	48.82		
86.00	49.15		
87.00	51.26		
88.00	56.35		
89.00	59.88		
90.00	55.91	53.30	51.43
91.00	56.24		
92.00 April 1	57.94		
93.00	59.19		
94.00	60.53		
95.00	60.28		
96.00	55.84		
	56.22		
	59.84		
99.00	62.84		
100.00	61.72	59.06	

75.00	49.71		
76.00	50.18		
77.00	51.00		
78.00	56.03		
79.00	52.44		
80.00	58.00	49.74	
81.00	51.91		
82.00	52.59		
83.00	56.38		
84.00	56.53		
85.00	49.82		
86.00	45.68		
87.00	48.12		
88.00	55.24		
89.00	58.44		
90.00	50.71	52.54	48.92
91.00	50.82		
92.00 April 1	54.19		
93.00	62.66		
94.00	64.75		
95.00	66.00		
96.00	64.66		
97.00	58.97		
98.00	59.56		
99.00	64.72		
100.00	66.59	61.29	

DAY MONTH	DAILY	10 DAY	30 DAY
101.00	61.06		
102.00	62.41		
103.00	64.00		
104.00	64.47		
105.00	61.28		
106.00	61.91		
107.00	64.75		
108.00	67.88		
109.00	68.09		
110.00	67.31	64.32	
111.00	66.38		
112.00	65.50		
113.00	64.63		
114.00	67.75		
115.00	65.19		
116.00	64.41		
117.00	62.22		
118.00	63.00		
119.00	64.25		
120.00	64.84	64.82	62.73
121.00	64.50		
122.00 May 1	67.72		
	63.84		
	64.66		
125.00	64.75		
126.00	66.09		

DAY MONTH	DAILY	10 DAY	30 DAY
101.00	65.31		
102.00	64.00		
103.00	64.56		
104.00	66.22		
105.00	63.16		
106.00	62.66		
107.00	67.53		
108.00	69.69		
109.00	66.28		
110.00	61.91	65.13	
111.00	59.84		
112.00	61.63		
113.00	64.44		
114.00	63.38		
115.00	59.34		
116.00	59.19		
117.00	61.78		
118.00	66.53		
119.00	63.56		
120.00	60.91	62.06	62.83
121.00	59.97		
122.00 May 1	63.69		
123.00	63.94		
124.00	67.59		
125.00	67.53		
126.00	68.88		

DAY MONTH DAILY 10 DAY 30 DAY

DAY MONTH DAILY 10 DAY 30 DAY

127.00	67.69		
128.00	68.22		
129.00	69.09		
130.00	68.91	66.55	
131.00	66.50		
132.00	68.34		
133.00	69.78		
134.00	68.19		
135.00	68.69		
136.00	68.81		
137.00	67.91		
138.00	69.69		
139.00	69.44		
140.00	71.84	68.92	
141.00	71.50		
142.00	72.63		
143.00	72.63		
144.00	74.13		
145.00	74.31		
146.00	73.88		
147.00	74.53		
148.00	72.38		
	73.78		
	74.66	73.44	69.64
151.00	75.59		
152.00	75.10		

127.00	70.47		
128.00	70.28		
129.00	71.53		
130.00	64.34	66.82	
131.00	64.09		
132.00	61.91		
133.00	64.22		
134.00	67.38		
135.00	68.91		
136.00	69.59		
137.00	71.16		
138.00	72.88		
139.00	72.19		
140.00	72.72	68.50	
141.00	70.13		
142.00	73.38		
143.00	74.34		
144.00	74.84		
145.00	74.66		
146.00	75.16		
147.00	75.88		
148.00	73.13		
149.00	75.47		
150.00	77.00	74.40	69.91
151.00	76.28		
152.00	77.43		

DAY MONTH DAILY 10 DAY 30 DAY

153.00	June 1	74.74		
154.00		74.29		
155.00		73.85		
156.00		75.21		
157.00		76.56		
158.00		77.03		
159.00		77.53		
160.00		76.82	75.67	
161.00		77.68		
162.00		77.79		
163.00		77.12		
164.00		77.79		
165.00		78.85		
166.00		79.29		
167.00		78.53		
168.00		77.76		
169.00		77.29		
170.00		77.79	77.99	
171.00		79.50		
172.00		79.29		
173.00		79.00		
174.00		78.76		
175.00		79.44		
176.00		79.41		
177.00		79.91		
178.00		79.38		

DAY MONTH DAILY 10 DAY 30 DAY

153.00	June 1	76.74		
154.00		71.68		
155.00		68.06		
156.00		72.76		
157.00		71.35		
158.00		74.59		
159.00		77.12		
160.00		77.12	74.31	
161.00		78.79		
162.00		76.09		
163.00		76.06		
164.00		80.47		
165.00		79.97		
166.00		79.88		
167.00		75.12		
168.00		72.32		
169.00		72.62		
170.00		75.91	76.72	
171.00		79.09		
172.00		78.12		
173.00		77.91		
174.00		78.18		
175.00		80.97		
176.00		78.41		
177.00		81.09		
178.00		82.00		

1

DAY MONTH	DAILY	10 DAY	30 DAY
179.00	78.97		
180.00	79.12	79.28	77.65
181.00	80.94		
182.00	81.91		
183.00 July 1	81.41		
184.00	81.09		
185.00	81.41		
186.00	81.24		
187.00	80.79		
188.00	80.18		
189.00	80.00		
190.00	81.03	81.00	
191.00	81.53		
192.00	82.62		
193.00	82.94		
194.00	82.29		
195.00	82.03		
196.00	82.50		
197.00	81.82		
198.00	82.12		
199.00	81.18		
200.00	82.09	82.11	
	82.44		
	82.65		
203.00	80.91		
204.00	80.26		

DAY MONTH	DAILY	10 DAY	30 DAY
179.00	81.94		
180.00	82.65	80.04	77.02
181.00	83.34		
182.00	83.21		
183.00 July 1	83.62		
184.00	83.29		
185.00	81.12		
186.00	83.21		
187.00	83.44		
188.00	83.24		
189.00	82.65		
190.00	83.97	83.11	
191.00	83.50		
192.00	84.29		
193.00	84.59		
194.00	84.62		
195.00	84.71		
196.00	84.15		
197.00	83.97		
198.00	84.79		
199.00	81.97		
200.00	82.68	83.93	
201.00	83.24		
202.00	81.76		
203.00	82.15		
204.00	82.38		

1

DAY MONTH	DAILY	10 DAY	30 DAY
205.00	81.71		
206.00	81.97		
207.00	81.82		
208.00	81.65		
209.00	80.91		
210.00	80.50	81.48	81.53
211.00	80.62		
212.00	79.32		
213.00	79.18		
214.00 Aug 1	79.56		
215.00	78.56		
216.00	78.76		
217.00	78.53		
218.00	78.47		
219.00	79.06		
220.00	80.12	79.22	
221.00	79.03		
222.00	80.41		
223.00	79.94		
224.00	78.65		
225.00	78.38		
226.00	78.18		
227.00	78.53		
228.00	80.09		
229.00	81.00		
230.00	79.91	79.41	

DAY MONTH	DAILY	10 DAY	30 DAY
205.00	83.12		
206.00	81.59		
207.00	80.21		
208.00	81.44		
209.00	82.03		
210.00	77.85	81.58	82.87
211.00	78.21		
212.00	78.21		
213.00	78.24		
214.00 Aug 1	78.44		
215.00	78.44		
216.00	74.91		
217.00	75.18		
218.00	75.56		
219.00	76.53		
220.00	77.79	77.15	
221.00	78.38		
222.00	80.18		
223.00	80.79		
224.00	76.56		
225.00	76.24		
226.00	75.18		
227.00	78.12		
228.00	78.65		
229.00	79.56		
230.00	77.56	78.12	

DAY MONTH DAILY 10 DAY 30 DAY

231.00	79.35		
232.00	79.09		
233.00	80.00		
234.00	80.41		
235.00	79.76		
236.00	78.44		
237.00	78.03		
238.00	78.68		
239.00	79.32		
240.00	79.03	79.21	79.28
241.00	78.06		
242.00	77.24		
243.00	76.94		
244.00	77.82		
245.00 Sept 1	76.85		
246.00	76.41		
247.00	76.88		
248.00	76.32		
249.00	76.44		
250.00	75.53	76.85	
251.00	76.15		
252.00	76.53		
253.00	76.24		
254.00	75.35		
255.00	72.18		
256.00	72.53		

DAY MONTH DAILY 10 DAY 30 DAY

231.00	79.06		
232.00	79.85		
233.00	82.71		
234.00	81.88		
235.00	80.24		
236.00	77.47		
237.00	77.88		
238.00	78.53		
239.00	78.44		
240.00	78.50	79.46	78.24
241.00	77.50		
242.00	79.00		
243.00	76.06		
244.00	77.91		
245.00 Sept 1	77.85		
246.00	76.03		
247.00	77.76		
248.00	77.56		
249.00	76.65		
250.00	77.65	77.40	
251.00	78.71		
252.00	76.91		
253.00	73.85		
254.00	70.59		
255.00	67.06		
256.00	68.85		

DAY MONTH DAILY 10 DAY 30 DAY

257.00	74.06		
258.00	74.56		
259.00	73.15		
260.00	72.94	74.37	
261.00	73.68		
262.00	72.12		
263.00	72.47		
264.00	72.15		
265.00	72.56		
266.00	70.50		
267.00	69.79		
268.00	69.09		
269.00	68.71		
270.00	69.53	71.06	74.09
271.00	70.26		
272.00	68.88		
273.00	67.18		
274.00	67.68		
275.00 Oct 1	68.62		
276.00	67.24		
277.00	65.09		
278.00	65.06		
	65.50		
	64.21	66.97	
281.00	63.38		
282.00	62.91		

DAY MONTH DAILY 10 DAY 30 DAY

257.00	71.24		
258.00	73.26		
259.00	72.62		
260.00	73.24	72.63	
261.00	74.03		
262.00	73.03		
263.00	72.00		
264.00	72.26		
265.00	73.56		
266.00	70.71		
267.00	70.18		
268.00	71.03		
269.00	65.71		
270.00	66.38	70.89	73.64
271.00	67.38		
272.00	67.26		
273.00	65.03		
274.00	64.82		
275.00 Oct 1	67.09		
276.00	65.50		
277.00	65.15		
278.00	69.62		
279.00	71.62		
280.00	71.88	67.54	
281.00	67.53		
282.00	61.62		

DAY MONTH	DAILY	10 DAY	30 DAY
283.00	63.35		
284.00	63.32		
285.00	63.82		
286.00	65.56		
287.00	66.74		
288.00	64.56		
289.00	64.35		
290.00	64.03	64.20	
291.00	60.53		
292.00	59.41		
293.00	59.12		
294.00	56.68		
295.00	58.59		
296.00	62.15		
297.00	60.94		
298.00	59.79		
299.00	55.82		
300.00	56.53	58.96	63.38
301.00	57.74		
302.00	55.74		
303.00	55.68		
304.00	57.21		
305.00	60.32		
Nov 1	60.56		
307.00	57.82		
308.00	56.32		

DAY MONTH	DAILY	10 DAY	30 DAY
283.00	62.09		
284.00	63.82		
285.00	72.97		
286.00	74.82		
287.00	68.59		
288.00	60.53		
289.00	55.71		
290.00	55.41	64.31	
291.00	58.00		
292.00	56.76		
293.00	57.85		
294.00	58.21		
295.00	63.00		
296.00	60.24		
297.00	57.09		
298.00	54.85		
299.00	53.18		
300.00	59.00	57.82	63.22
301.00	60.03		
302.00	51.85		
303.00	53.18		
304.00	56.44		
305.00	61.03		
Nov 1	55.38		
307.00	52.53		
308.00	50.38		

DAY MONTH	DAILY	10 DAY	30 DAY
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DAY MONTH	DAILY	10 DAY	30 DAY
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309.00	53.62		
310.00	53.00	56.80	
311.00	54.94		
312.00	55.26		
313.00	54.71		
314.00	55.74		
315.00	53.59		
316.00	51.09		
317.00	50.97		
318.00	51.15		
319.00	51.79		
320.00	50.15	52.94	
321.00	50.44		
322.00	52.18		
323.00	51.41		
324.00	51.09		
325.00	51.24		
326.00	49.74		
327.00	49.38		
328.00	48.74		
329.00	49.71		
330.00	48.03	50.19	53.31
	49.59		
	51.38		
333.00	45.85		
334.00	42.74		

309.00	49.82		
310.00	47.44	53.81	
311.00	51.85		
312.00	56.53		
313.00	59.15		
314.00	54.88		
315.00	54.18		
316.00	55.29		
317.00	53.21		
318.00	55.59		
319.00	45.62		
320.00	41.76	52.81	
321.00	45.12		
322.00	52.35		
323.00	58.09		
324.00	46.15		
325.00	46.65		
326.00	47.06		
327.00	48.32		
328.00	50.68		
329.00	52.41		
330.00	53.09	49.99	52.20
331.00	48.47		
332.00	50.38		
333.00	42.88		
334.00	39.35		

DAY MONTH	DAILY	10 DAY	30 DAY
335.00	43.71		
336.00 Dec 1	44.00		
337.00	45.97		
338.00	45.68		
339.00	45.59		
340.00	45.41	45.99	
341.00	48.03		
342.00	45.53		
343.00	44.32		
344.00	42.09		
345.00	42.29		
346.00	43.35		
347.00	43.53		
348.00	45.09		
349.00	44.56		
350.00	43.15	44.19	
351.00	41.50		
352.00	39.91		
353.00	39.82		
354.00	43.62		
355.00	44.56		
356.00	42.15		
357.00	42.03		
358.00	43.12		
359.00	44.56		
360.00	40.32	42.16	44.11

DAY MONTH	DAILY	10 DAY	30 DAY
335.00	39.91		
336.00 Dec 1	41.68		
337.00	44.32		
338.00	44.24		
339.00	43.62		
340.00	44.15	43.90	
341.00	46.88		
342.00	46.21		
343.00	41.97		
344.00	41.91		
345.00	42.12		
346.00	43.03		
347.00	40.35		
348.00	42.79		
349.00	47.15		
350.00	43.82	43.62	
351.00	39.97		
352.00	39.24		
353.00	41.03		
354.00	44.74		
355.00	42.47		
356.00	42.38		
357.00	42.53		
358.00	43.59		
359.00	40.38		
360.00	40.12	41.64	43.06

DAY MONTH	DAILY	10 DAY	30 DAY
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361.00	38.26		
362.00	40.50		
363.00	41.97		
364.00	41.41		
365.00	42.18		
366.00	42.26	41.10	41.10

AVG YEAR DATA

Avg Day yerly Temp	61.13 Deg F
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Avg Day crop seas	76.31 Deg F
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Avg Day off-seas	50.79 Deg F
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DAY MONTH	DAILY	10 DAY	30 DAY
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361.00	38.03		
362.00	40.32		
363.00	43.68		
364.00	44.53		
365.00	41.59		
366.00	39.82	41.33	41.33

DRY YEAR DATA 1969

Avg Day yerly Temp	60.83 Deg F
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Avg Day crop seas	76.18 Deg F
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Avg Day off-seas	50.35 Deg F
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APPENDIX E

PROCEDURE FOR DETERMINING RUNOFF CAPTURE

PROCEDURE FOR DETERMINING RUNOFF CAPTURE

The amount of runoff per month is computed as a fixed percent of the selected monthly rainfall and is established based on previous analysis of stream gage data in Eastern Arkansas. The monthly runoff used is as follows:

Monthly Runoff as Percent of Monthly Rainfall

Month	Runoff (% Precipitation)	Percent Runoff Potentially Captured
January	38	62
February	58	42
March	76	24
April	40	60
May	26	74
June	14	86
July	14	86
August	14	86
September	16	84
October	4	96
November	4	96
December	17	83

Likewise the amount of runoff that can practically be captured with a tailwater recovery system is estimated as a varying percent of the runoff value. The monthly percentage used in this analysis is estimated as being inversely proportional to the percent of rain that produces runoff and is shown in the above table.

The runoff capture values are used in the SCS water budget program to determine the supply effects of tailwater recovery.

APPENDIX F

TYPICAL PLANTING AND HARVEST DATES

UNITED STATES
DEPT of AGRICULTURE

SOIL CONSERVATION SERVICE

DATE: July 29, 1992

Mr. Larry Farris
CONSERVATION AGRONOMIST
LITTLE ROCK, AR 72201

Larry I have need for some information on crop planting and harvesting dates for the Grand Prairie Irrigation Project. This will affect the irrigation needs for this project.

This is a list for the following crops needed:

crop	planting date	harvest date
early soybeans	<u>May 15</u>	<u>October 15</u>
late soybeans	<u>June 20</u>	<u>November 1</u>
rice	<u>April 1</u>	<u>August 20</u>
grain sorghum	<u>March 20</u>	<u>August 20</u>
corn-grain	<u>March 15</u>	<u>August 25</u>
winter wheat	<u>November 1</u>	<u>June 10</u>
sod-grass (Bermuda grass)	<u>Greenup May 1</u>	<u>→ Frost</u>

This information is needed within 10 calendar days and sent to the Dewitt Field Office attn: Randy Brown. Thank you in your assistance in this matter.

Signature: Larry D. Farris

Date: 8-3-92

Randy Brown
Randy Brown
Project Engineer

APPENDIX G

ALLDATA.DAT DATA FILE PRINTOUT

ALLDATA.DAT DATA FILE PRINTOUT AND HEADING EXPLANATION

The following information lists the column heading, the column title, the units of the data, and an explanation of the data for the ALLDATA.DAT data file. This file was utilized by the GP.SS program to compute the import water requirement for individual tracts of land located within the project boundary.

trno - tract number (no) - A unique number used to identify a parcel of land within the project area. (See Section for a detailed explanation of tract numbers.)

tfrmlnd - tract farmland (ac) - The total area of the tract.

tcrplnd - tract cropland (ac) - The area of the tract used to produce crops in 1991 (including grass and hay).

fno - farm number (no) - A number assigned by county ASCS personnel to one or more tracts operated by one individual or a group of individuals. Farm numbers are unique within county boundaries.

ffrmlnd - farm farmland (ac) - The combined total area of all tracts listed under this farm number.

fcrrplnd - farm cropland (ac) - The combined total cropland (tcrplnd) acreage for all tracts listed under this farm number.

frice - farm rice (ac) - The combined total base rice acreage for all tracts listed under this farm number.

fwht - farm wheat (ac) - The combined total base wheat acreage for all tracts listed under this farm number.

foats - farm oats (ac) - The combined total base oat acreage for all tracts listed under this farm number.

fcorn - farm corn (ac) - The combined total base corn acreage for all tracts listed under this farm number.

fgrsrg - farm grain sorghum - The combined total base grain sorghum acreage for all tracts listed under this farm number.

fother - farm other (ac) - The combined total acreage for all other cultivated base crops for all tracts listed under this farm number.

crp - conservation reserve program (ac) - The tract cropland currently enrolled in the Conservation Reserve Program which requires the establishment of permanent vegetative cover such as grass or trees.

cacres - c acres (ac) - The tract cropland acres currently reported as permanent pasture, hayland, or other non-irrigated crops.

coe_no - corps of engineers number (no) - The aerial photograph number on which the boundaries of this tract are outlined.

sec - section (no) - The legal section in which the major portion of the tract is located.

twnshp - township (no) - The township in which the major portion of the tract is located.

range - range (no) - The range in which the major portion of the tract is located.

cell_no - cell number (no) - The USGS/COE cell number in which the major portion of the tract is located. A cell is a referenced grid area nine square miles in size.

fpa - fish pond acres (ac) - The total surface area of commercial fish ponds on the tract.

fpd - fish pond depth (ft) - The estimated average depth of commercial fish ponds on the tract.

irgsa - irrigation storage acres (ac) - The total surface area of existing irrigation storage reservoirs on the tract.

irgsd - irrigation storage depth (ft) - The estimated average depth of irrigation storage reservoirs on the tract.

fwa - fish and wildlife acres (ac) - The total surface area of water bodies on the tract used primarily for fish and wildlife habitat.

fwd - fish and wildlife depth (ft) - The estimated average depth of water bodies on the tract used primarily for fish and wildlife habitat.

oa - other acres (ac) - The total surface area of any other water bodies on the tract.

offtract_no - off-tract number (no) - The tract number of a tract with reservoir from which this tract receives water.

pctofftr - percent off-tract (%) - The percentage of the volume of a reservoir located on another tract used on this tract.

peralta - peralta (ac-ft) - The volume of groundwater available for use without damage to the aquifer according to the USGS/COE (Peralta) computer model.

pctontr - percent on-tract (%) - The percentage of the volume of storage reservoirs located on this tract to be used on this tract. Note: Some reservoirs supply water to more than one tract.

offtrcap - off-tract capacity (ac-ft) - The total volume of storage in a reservoir located on another tract from which this tract receives water.

1-1

trno	tfrmld	terplnd	fno	ffrmld	ferplnd	frice	fwht	foats	fcorn	fgrsrg
100020	20.0	5.5	6	20.0	5.5					
100030	80.0	45.5	7	80.0	45.5					
100040	40.0	5.5	8	40.0	5.5					
100050	80.0	23.8	9	80.0	23.8		0.0			
100100	160.0	148.4	12	260.0	251.3	80.1	7.2	5.1		82.2
100110	80.0	75.0	12	260.0	251.3	80.1	7.2	5.1		82.2
100120	20.0	27.1	12	260.0	251.3	80.1	7.2	5.1		82.2
100130	440.0	136.7	13	440.0	136.7		9.3			
100140	40.0	36.9	14	40.0	36.9		5.9			8.9
100150	70.0	42.3	191	136.0	70.2	13.0	16.6			5.2
100160	85.0	26.5	15	85.0	26.5					
100170	74.0	41.6	16	74.0	41.6		2.2			4.6
100180	400.0	351.1	17	400.0	351.1	197.5				
100200	21.0	6.2	19	21.0	6.2					
100210	40.0	30.6	1505	1003.0	740.7	194.2	130.9	129.1		170.2
100230	80.0	72.0	1501	470.0	347.4	116.3	46.3	0		0.0
100240	40.0	35.1	1501	470.0	347.4	116.3	46.3	0		0.0
100280	220.0	163.5	1699	820.0	679.6	205.1	246.5			28.0
100290	646.0	485.3	27	646.0	485.6	122.5	82.8	129.6		98.1
100300	320.0	296.6	28	320.0	296.6	181.8	84.2			
100310	441.0	369.8	29	441.0	369.8	151.9	54.3	11.0		37.1
100320	40.0	28.6	30	40.0	28.6					
100330	14.0	12.1	31	14.0	12.1		9.8			
100340	300.0	364.0	32	460.0	439.9	170.6	114.8			
100350	80.0	75.9	32	460.0	439.9	170.6	114.8			
100360	91.0	13.6	33	91.0	13.6					
100370	10.0	6.0	1829	135.0	91.3	54.1				
100380	71.0	41.2	40	71.0	41.2					
100390	20.0	7.0	42	20.0	7.0					
100430	160.0	155.7	45	160.0	155.7	55.1	44.4			
100440	80.0	68.3	46	160.0	146.4	40.0	42.7	1		
100450	80.0	78.1	46	160.0	146.4	40.0	42.7	1		
100460	10.0	7.9	47	10.0	7.9					
100470	240.0	234.3	1831	280.0	273.3	76.7	69	0		15.9
100500	640.0	597.7	49	640.0	597.7	137.0	130.6			83.0
100510	30.0	20.1	51	30.0	20.1					
100520	40.0	24.0	53	40.0	24.0					
100530	25.0	0.0	54	385.0	216.1	4.0		12		
100540	160.0	87.3	54	285.0	216.1	4.0		12		
100560	310.0	296.0	1730	1022.0	898.1	207.4	179	89.7		
100570	83.0	7.5	1730	1022.0	898.1	207.4	179	89.7		
100580	5.0	4.1	59	5.0	4.1					
100620	80.0	23.5	1481	193.0	101.8	59.9	6.8			2.0
100630	10.0	6.0	67	10.0	6.0					
100640	1000.0	891.2	69	1000.0	891.2	295.4	160.3			88.5
100660	240.0	230.0	73	240.0	230.0	74.9	17.8			12.5
100670	350.0	337.4	74	350.0	337.4	131.6	100.3	4.5		13.6
100690	360.0	336.6	77	500.0	541.0	201.3	96.4	80.0		160.4
100700	220.0	205.2	77	500.0	541.0	201.3	96.4	80.0		160.4
100710	104.0	101.4	79	264.0	246.3	50.4	63.1		121.7	0.0
100720	160.0	144.9	79	264.0	246.3	50.4	63.1		121.7	0.0
100730	160.0	114.3	81	160.0	114.3	50.1	20.8			11.0
100740	360.0	166.7	83	720.0	429.0	167.4	91.9			57.1
100750	360.0	262.3	83	720.0	429.0	167.4	91.9			57.1
100760	200.0	142.3	85	200.0	142.3	50.4	51.3			
100770	46.0	28.9	87	46.0	28.9		0			0.0
100790	80.0	54.5	90	80.0	54.5	27.0	25.8			0.0
100800	600.0	160.7	96	600.0	160.7		45.7			

trno	fother	crp	cacres	coe_no	sec	twshp	range	cell_no	fpa	fpd
100020				11184	3	5s	3w	5420		
100030		45.0	0.5	10170	20	4s	3w	5319		
100040				12200	18	5s	2w	5521		
100050				11185	26	4s	3w	5420		
100100				8235	10	4s	4w	5318		
100110				8235	23	4s	4w	5318		
100120				8235	23	4s	4w	5318		
100130		20.0	116.7	10171	27	4s	3w	5420		
100140				10171	27	4s	3w	5320		
100150			16.3	11184	35	4s	3w	5420		
100160				10170	22	4s	3w	5319		
100170				10173	5	5s	3w	5419		
100180				918	14	4s	4w	5318		
100200				12200	8	5s	2w	5521		
100210				12200	8	5s	2w	5521		
100230				11183	14	5s	3w	5520		
100240				11183	13	5s	2w	5520		
100280				10174	8	5s	3w	5419		
100290				920	36	4s	4w	5418		
100300				10176	20	5s	3w	5519		
100310				10170	20	4s	3w	5319		
100320				11185	23	4s	3w	5320		
100330				11184	35	4s	3w	5420		
100340				11180	25	5s	3w	5520		
100350				11180	25	5s	3w	5520		
100360				11184	3	5s	3w	5420		
100370			6	11184	35	4s	3w	5420		
100380				10172	34	4s	3w	5419		
100390				10171	27	4s	3w	5319		
100430				11182	24	5s	3w	5520		
100440				11180	25	5s	3w	5520		
100450				11180	25	5s	3w	5620		
100460				10170	21	4s	3w	5319		
100470				10174	22	5s	3w	5520		
100500				10173	8	5s	3w	5519		
100510				919	18	4s	3w	5319		
100520				11184	1	5s	3w	5420		
100530				11184	3	5s	3w	5419		
100540			21.6	10174	10	5s	3w	5419	27.5	8.0
100560				10174	16	5s	3w	5519		
100570			7.5	12200	17	5s	2w	5521		
100580				10171	20	4s	3w	5419		
100620			5.2	10172	32	4s	3w	5419		
100630				10172	32	4s	3w	5419		
100640			96.9	12200	20	5s	2w	5521		
100660				11180	26	5s	3w	5520		
100670				11180	26	5s	3w	5620		
100690			6.3	8233	35	4s	4w	5418		
100700				8235	23	4s	4w	5318		
100710				917	6	4s	3w	5218		
100720				10170	20	4s	3w	5319		
100730				918	24	4s	4w	5318		
100740			3	918	24	4s	4w	5418		
100750			6.1	8235	22	4s	4w	5418		
100760			52.3	12200	16	5s	2w	5521		
100770			6.2	10170	20	4s	3w	5319		
100790			2.4	12200	7	5s	2w	5521		
100800		70.0	90.7	12200	16	5s	2w	5521		

trno	irgsa	irgsd	fwa	fwd	oa	offtr_no	pctofftr	peralta	pctontr	offtrcap
100020								3017	100	
100030								11	100	
100040								1391	100	
100050								3017	100	
100100								11	100	
100110								11	100	
100120								11	100	
100130								3017	100	
100140								3062	100	
100150								3017	100	
100160								11	100	
100170								11	100	
100180								11	100	
100200								1391	100	
100210								1391	100	
100230								11	100	
100240								11	100	
100280								11	100	
100290								11	100	
100300								11	100	
100310	27.5	5						11	100	
100320								3062	100	
100330								3017	100	
100340								11	100	
100350								11	100	
100360								3017	100	
100370								3017	100	
100380								11	100	
100390								11	100	
100430								11	100	
100440								11	100	
100450								11	100	
100460								11	100	
100470								11	100	
100500								11	100	
100510								11	100	
100520								3017	100	
100530								11	100	
100540								11	100	
100560								11	100	
100570								1391	100	
100580								11	100	
100620								11	100	
100630								11	100	
100640								1391	100	
100660								11	100	
100670								11	100	
100690								11	100	
100700								11	100	
100710								11	100	
100720								11	100	
100730			5.7	3.5				11	100	
100740						100750	50	11	100	355.16
100750	68.3	5.2						11	50	
100760								1391	100	
100770								11	100	
100790								1391	100	
100800								1391	100	

APPENDIX H

GP.OUT COMPUTER OUTPUT FILE PRINTOUT

GP.OUT COMPUTER OUTPUT FILE AND HEADING EXPLANATION

The following information lists the column heading, the column title, the units of the data, and an explanation of the data for the output file produced from the GP.SS computer program. This program processes data and calculates water requirements on an individual tract basis. The data in this file represent the "with project" results unless otherwise noted.

trno - tract number (no) - A unique number used to identify a parcel of land within the project area.

scrac - summary cropland acres (ac)- The amount of cropland (including CRP and grassland) remaining in the tract after computing the reservoir requirements. All new reservoirs are planned to be constructed on cultivated cropland.

strac - summary tract acres (ac) - The total amount of land in the tract.

sirgac - summary irrigated acres (ac) - The amount of irrigated cropland in the tract. This value is equivalent to scrac less CRP and grassland.

isdmd - in-season demand (af) - The total water requirement during the period of May through September after conservation measures are installed.

osdmd - off-season demand (af) - The total water requirement during the period from October through April. This value includes fish and wildlife, and irrigation reservoir recharge requirements.

pmoaf - peak monthly acre feet (af) - The maximum total amount of water required during any calendar month of the period of May through September.

pmogpma - peak monthly gallons per minute per acre (gpm/ac) - The maximum monthly flow rate necessary to supply the total water requirement during the peak use period of the year.

effrice - efficiency of rice (%) - The estimated average efficiency for rice irrigation in the project area.

effother - efficiency of other (%) - The estimated average efficiency for the irrigation of crops other than rice in the project area.

strgexst - storage existing (ac-ft) - The estimated storage volume of all existing irrigation storage reservoirs located on an individual tract.

strgpln - storage planned (ac-ft) - The volume of additional storage reservoirs planned in excess of existing storage reservoirs on an individual tract.

strgtot - storage total (ac-ft) - The total storage volume of existing and planned storage reservoirs on an individual tract.

strgusd - storage used (ac-ft) - The total storage volume used for irrigation on an individual tract. It includes water from existing, planned, and off-tract reservoirs. *THIS WATER COMES FROM OFF-SEASON IMPORT AND OFF-SEASON CAPTURE.*

twcap - tailwater capture (ac-ft) - The volume of tailwater and runoff captured from the irrigated cropland on an individual tract. *(1st SEASON ONLY)*

gw - groundwater (ac-ft) - The volume of groundwater used for irrigation of an individual tract without depletion of the resource.

oswi - off-season water import (ac-ft) - The volume of surface water to be imported for an individual tract during the months of October through April.

iswi - in-season water import (ac-ft) - The volume of surface water to be imported for an individual tract during the months of May through September.

pdevaf - peak delivery acre feet (ac-ft/mo) - The maximum monthly volume of water to be imported for an individual tract during the growing season.

pdevgpm - peak delivery gallons per minute (gpm/ac) - The flow rate required to supply the peak delivery acre feet (pdevaf) during a 30 day, 20 hour/day period.

mxdevq - maximum delivery q (cfs) - The peak delivery gallons per minute (pdevgpm) expressed in cubic feet per second.

fish - fish (ac) - The existing surface area of commercial fish ponds located on the tract.

rice - rice (ac) - The rice acreage on the tract after any reductions for planned storage reservoirs. Planned reservoir acreage is taken first from early soybean acreage, second from late soybean acreage, and last from rice acreage.

lbeans - late beans (ac) - The double crop soybean/wheat acreage on the tract after any reductions for planned storage reservoirs. Planned reservoir acreage is taken first from early soybean acreage, second from late soybean acreage, and last from rice acreage.

ebeans - early beans (ac) - The full season soybean acreage on the tract after any reductions for planned storage reservoirs. Planned reservoir acreage is taken first from early soybean acreage, second from late soybean acreage, and last from rice acreage.

corn - corn (ac) - The existing corn acreage on the tract.

grsrg - grain sorghum (ac) - The existing grain sorghum acreage on the tract.

oirr - other irrigated (ac) - Any cropland on the tract not included in the primary crop categories.

totcrop - total cropland (ac) - The cropland on the tract after any reductions for planned storage reservoirs.

wflcrplnd - wildlife flooded cropland (ac) - The cropland on the tract planned for waterfowl flooding from October through December. This value is set as a constant percentage of totcrop.

irgres - irrigation reservoirs (ac) - The total surface area of all existing and planned irrigation storage reservoirs on the tract.

tothoh - total water (ac) - The total surface area of all existing and planned water bodies on an individual tract.

offseaq - off-season q (cfs) - The maximum flow rate required on the tract during the months of October through April for filling reservoirs or flooding for wildlife.

priorcrop - prior cropland (ac) - The amount of existing cropland on the tract, including grassland and Conservation Reserve Program (CRP) acres.

priorirrg - prior irrigated (ac) - The amount of existing cropland on the tract, excluding grassland and CRP acres.

pctofftr - percent off-tract (%) - The percentage of the volume of a reservoir located on another tract used on this tract.

offtrno - off-tract number (no) - The tract number of a tract with a reservoir from which this tract receives water.

priebns - prior early beans (ac) - The existing full season soybean acreage on the tract.

offtraf - off-tract acre feet (ac-ft) - The total volume of storage in a reservoir located on another tract from which this tract receives water.

offtraaf - off-tract available acre feet (ac-ft) - The volume of storage in a reservoir located on another tract to be used on this tract.

fwac - fish and wildlife acres (ac) - The surface area of water bodies located on the tract with a primary purpose of providing fish and wildlife habitat.

ontrstgusd - on-tract storage used (ac-ft) - The volume of storage in a reservoir located on this tract to be used on this tract. Note: Some reservoirs supply water to more than one tract.

potstrgav - potential storage available (ac-ft) - The total volume of storage available for use on the tract. This includes existing reservoirs on the tract which are larger than needed or storage on another tract which is used on this tract.

insea24q - in-season 24 hour q (cfs) - The maximum sustained flow rate required to deliver the planned in-season import water without system interruptions.

ontrstrgac - on-tract storage acres (ac) - The total surface area of existing and planned storage reservoirs on the tract.

ontrstrgdp - on-tract storage depth (ft) - The average depth of existing and planned storage reservoirs on the tract.

pcontrstrgusd - percent on-tract storage used (%) - The percentage of water stored in reservoirs on the tract to be used on the tract. Note: Some reservoirs supply water to more than one tract.

trno	scrac	strac	sirgac	isdac	osdac	pnoaf	pnogpmac	effrice	effother	strgext
100020	5.2	20.0	5.2	10	3	4	5.51	70.0	70.0	0
100030	45.5	90.0	0.0	0	0	0	0.00	70.0	70.0	0
100040	5.2	40.0	5.2	10	3	4	5.51	70.0	70.0	0
100050	22.7	80.0	22.7	41	11	17	5.45	70.0	70.0	0
100100	140.8	160.0	140.8	289	61	102	5.44	70.0	70.0	0
100110	71.9	80.0	71.9	140	42	52	5.44	70.0	70.0	0
100120	25.7	20.0	25.7	53	15	19	5.44	70.0	70.0	0
100130	136.7	440.0	0.0	0	0	0	0.00	70.0	70.0	0
100140	35.3	40.0	35.3	61	17	20	4.23	70.0	70.0	0
100150	41.1	70.0	24.8	46	13	15	4.60	70.0	70.0	0
100160	25.3	85.0	25.3	47	12	19	5.51	70.0	70.0	0
100170	39.7	74.0	39.7	71	19	25	4.00	70.0	70.0	0
100180	330.9	400.0	330.9	764	209	266	6.01	70.0	70.0	0
100200	5.9	21.0	5.9	11	3	4	5.51	70.0	70.0	0
100210	29.2	40.0	29.2	54	16	18	4.70	70.0	70.0	0
100230	68.3	80.0	68.3	140	39	47	5.15	70.0	70.0	0
100240	33.3	40.0	33.3	68	19	23	5.15	70.0	70.0	0
100280	155.3	220.0	155.3	311	89	106	5.09	70.0	70.0	0
100290	463.3	646.0	463.3	835	245	282	4.56	70.0	70.0	0
100300	281.8	320.0	281.8	560	157	187	4.96	70.0	70.0	0
100310	363.9	441.0	363.9	763	196	262	5.39	70.0	70.0	138
100320	27.3	40.0	27.3	50	13	20	5.51	70.0	70.0	0
100330	11.7	14.0	11.7	17	5	6	4.13	70.0	70.0	0
100340	345.5	380.0	345.5	703	197	237	5.13	70.0	70.0	0
100350	72.0	80.0	72.0	147	41	49	5.13	70.0	70.0	0
100360	13.0	91.0	13.0	24	6	10	5.51	70.0	70.0	0
100370	6.0	10.0	0.0	0	0	0	0.00	70.0	70.0	0
100380	39.3	71.0	39.3	72	19	29	5.51	70.0	70.0	0
100390	6.7	20.0	6.7	12	3	5	5.51	70.0	70.0	0
100430	147.9	160.0	147.9	295	83	99	4.99	70.0	70.0	0
100440	64.9	80.0	64.9	120	36	43	4.90	70.0	70.0	0
100450	74.3	80.0	74.3	146	41	49	4.90	70.0	70.0	0
100460	7.5	16.0	7.5	14	4	6	5.51	70.0	70.0	0
100470	222.9	240.0	222.9	432	121	145	4.85	70.0	70.0	0
100500	569.3	640.0	569.3	1079	304	362	4.76	70.0	70.0	0
100510	19.2	30.0	19.2	35	9	14	5.51	70.0	70.0	0
100520	22.9	40.0	22.9	42	11	17	5.51	70.0	70.0	0
100530	0.0	25.0	0.0	0	0	0	0.00	70.0	70.0	0
100540	83.8	160.0	62.2	135	91	50	6.07	70.0	70.0	0
100560	281.5	310.0	281.5	551	155	184	4.88	70.0	70.0	0
100570	7.5	83.0	0.0	0	0	0	0.00	70.0	70.0	0
100580	4.1	5.0	4.1	7	0	3	5.43	70.0	70.0	0
100620	22.5	80.0	17.3	40	11	14	6.00	70.0	70.0	0
100630	5.7	10.0	5.7	11	3	4	5.51	70.0	70.0	0
100640	851.2	1000.0	754.3	1516	424	516	5.11	70.0	70.0	0
100660	218.1	240.0	218.1	450	123	152	5.23	70.0	70.0	0
100670	320.6	350.0	320.6	639	182	216	5.04	70.0	70.0	0
100690	320.5	360.0	314.2	616	170	217	5.15	70.0	70.0	0
100700	195.2	220.0	195.2	303	110	135	5.15	70.0	70.0	0
100710	96.2	104.0	96.2	190	56	73	5.66	70.0	70.0	0
100720	137.5	160.0	137.5	283	80	104	5.66	70.0	70.0	0
100730	108.3	160.0	108.3	228	65	79	5.44	70.0	70.0	0
100740	166.7	360.0	163.7	325	14	111	5.09	70.0	70.0	0
100750	262.3	360.0	256.2	561	134	194	5.66	70.0	70.0	355
100760	137.8	200.0	85.5	171	48	57	5.00	70.0	70.0	0
100770	27.0	46.0	21.6	40	11	16	5.51	70.0	70.0	0
100790	51.9	80.0	49.5	100	29	34	5.17	70.0	70.0	0
100800	160.7	600.0	0.0	0	0	0	0.00	70.0	70.0	0

trno	strgpln	strgtot	strgsud	twcap	gw	oswi	iswi	pdevaf	pdevgpm
100020	3	3	3	1	3	1	4	1	1.55
100030	0	0	0	0	0	0	0	0	0.00
100040	3	3	3	1	1	1	5	2	2.39
100050	11	11	11	3	12	3	15	5	1.62
100100	76	76	76	33	0	33	179	62	3.31
100110	39	39	39	17	0	17	91	32	3.31
100120	14	14	14	6	0	6	33	11	3.31
100130	0	0	0	0	0	0	0	0	0.00
100140	16	16	16	8	19	5	16	7	1.41
100150	12	12	12	6	13	4	14	5	1.54
100160	12	12	12	4	0	4	28	13	3.82
100170	19	19	19	7	0	6	44	17	3.22
100180	184	184	184	77	0	94	503	164	3.72
100200	3	3	3	1	1	1	6	2	2.39
100210	14	14	14	7	6	6	27	7	1.88
100230	37	37	37	16	0	15	87	29	3.13
100240	18	18	18	8	0	7	43	14	3.13
100280	80	80	80	36	0	35	195	58	2.79
100290	205	205	205	107	0	86	523	152	2.46
100300	148	148	148	65	1	60	346	108	2.06
100310	54	192	192	81	0	74	489	155	3.18
100320	13	13	13	4	14	4	18	6	1.55
100330	4	4	4	2	6	1	1	5	3.29
100340	185	185	185	80	1	78	436	136	2.94
100350	39	39	39	17	0	16	91	28	2.94
100360	6	6	6	2	7	2	9	3	1.55
100370	0	0	0	0	0	0	0	0	0.00
100380	19	19	19	6	0	6	44	20	3.82
100390	3	3	3	1	0	1	8	3	3.02
100430	78	78	78	34	0	32	183	57	2.87
100440	34	34	34	15	0	14	79	25	2.83
100450	38	38	38	17	0	15	90	28	2.83
100460	4	4	4	1	0	1	8	4	3.82
100470	114	114	114	52	0	45	266	84	2.82
100500	284	284	284	132	1	108	661	210	2.76
100510	9	9	9	3	0	3	22	10	3.82
100520	11	11	11	3	12	3	16	5	1.55
100530	0	0	0	0	0	0	0	0	0.00
100540	35	35	35	10	0	70	86	36	4.33
100560	145	145	145	65	1	58	340	106	2.82
100570	0	0	0	0	0	0	0	0	0.00
100580	0	0	0	1	0	0	6	3	6.25
100620	9	9	9	4	0	5	26	8	3.67
100630	3	3	3	1	0	1	6	3	3.82
100640	400	400	400	175	170	164	772	231	2.29
100660	119	119	119	51	0	48	280	93	3.18
100670	168	168	168	74	1	71	395	119	2.78
100690	161	161	161	73	0	69	382	123	2.92
100700	100	100	100	45	0	43	237	76	2.92
100710	52	52	52	22	0	23	122	44	3.39
100720	74	74	74	32	0	33	174	62	3.39
100730	56	56	56	25	0	27	147	45	3.11
100740	0	0	161	36	0	7	128	33	1.52
100750	0	355	173	56	0	50	331	102	2.97
100760	45	45	45	20	21	18	65	25	2.16
100770	11	11	11	3	0	3	24	11	3.82
100790	26	26	26	11	0	12	54	14	2.17

trno	mxdevq	fish	rice	lbeans	ebeans	corn	grsrg	oorg	totcrop	wflcrplnd
100020	0.02	0.0	0.0	0.0	5.2	0.0	0.0	0.0	5.2	0.5
100030	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.5	0.0
100040	0.03	0.0	0.0	0.0	5.2	0.0	0.0	0.0	5.2	0.5
100050	0.00	0.0	0.0	0.0	21.9	0.0	0.0	0.0	22.7	2.3
100100	1.04	0.0	52.0	7.3	32.9	0.0	40.5	0.0	140.8	14.1
100110	0.53	0.0	26.6	3.7	16.8	0.0	24.8	0.0	71.9	7.2
100120	0.19	0.0	9.5	1.3	6.0	0.0	8.9	0.0	25.7	2.6
100130	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	136.7	0.0
100140	0.11	0.0	0.0	5.9	20.5	0.0	8.9	0.0	35.3	3.5
100150	0.00	0.0	4.8	6.1	11.9	0.0	1.9	0.0	41.1	2.5
100160	0.22	0.0	0.0	0.0	25.3	0.0	0.0	0.0	25.3	2.5
100170	0.20	0.0	0.0	2.2	32.9	0.0	4.6	0.0	39.7	4.0
100180	2.74	0.0	197.5	0.0	133.4	0.0	0.0	0.0	330.9	33.1
100200	0.03	0.0	0.0	0.0	5.9	0.0	0.0	0.0	5.9	0.6
100210	0.12	0.0	0.0	11.1	3.1	0.0	7.0	0.0	29.2	2.9
100230	0.40	0.0	24.1	9.6	34.6	0.0	0.0	0.0	68.3	6.8
100240	0.23	0.0	11.8	4.7	16.9	0.0	0.0	0.0	33.3	3.3
100280	0.97	0.0	68.6	59.3	28.7	0.0	6.7	0.0	155.3	15.5
100290	2.54	0.0	122.4	212.3	30.5	0.0	90.0	0.0	463.3	46.3
100300	1.00	0.0	101.0	84.2	95.8	0.0	0.0	0.0	281.8	28.2
100310	2.50	0.0	151.9	66.1	108.8	0.0	37.1	0.0	363.9	36.4
100320	0.09	0.0	0.0	0.0	27.3	0.0	0.0	0.0	27.3	2.7
100330	0.09	0.0	0.0	9.8	1.9	0.0	0.0	0.0	11.7	1.2
100340	2.26	0.0	141.2	95.0	109.3	0.0	0.0	0.0	345.5	34.5
100350	0.47	0.0	29.4	19.8	22.8	0.0	0.0	0.0	72.0	7.2
100360	0.04	0.0	0.0	0.0	13.0	0.0	0.0	0.0	13.0	1.3
100370	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0
100380	0.33	0.0	0.0	0.0	39.3	0.0	0.0	0.0	39.3	3.9
100390	0.06	0.0	0.0	0.0	6.7	0.0	0.0	0.0	6.7	0.7
100430	0.95	0.0	55.1	44.4	48.4	0.0	0.0	0.0	147.9	14.8
100440	0.41	0.0	22.4	20.4	22.2	0.0	0.0	0.0	64.9	6.5
100450	0.47	0.0	25.6	23.3	25.3	0.0	0.0	0.0	74.3	7.4
100460	0.06	0.0	0.0	0.0	7.5	0.0	0.0	0.0	7.5	0.8
100470	1.40	0.0	65.0	59.2	84.4	0.0	13.6	0.0	222.9	22.3
100500	3.50	0.0	137.8	130.6	209.9	0.0	83.0	0.0	569.3	56.9
100510	0.16	0.0	0.0	0.0	19.2	0.0	0.0	0.0	19.2	1.9
100520	0.00	0.0	0.0	0.0	22.9	0.0	0.0	0.0	22.9	2.3
100530	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
100540	0.60	27.5	1.2	3.6	57.4	0.0	0.0	0.0	83.8	6.2
100560	1.77	0.0	94.7	88.6	98.2	0.0	0.0	0.0	281.5	28.1
100570	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	0.0
100580	0.06	0.0	0.0	0.0	4.1	0.0	0.0	0.0	4.1	0.4
100620	0.14	0.0	10.0	1.2	4.9	0.0	0.4	0.0	22.5	1.7
100630	0.05	0.0	0.0	0.0	5.7	0.0	0.0	0.0	5.7	0.6
100640	3.85	0.0	263.3	142.9	269.3	0.0	78.9	0.0	851.2	75.4
100660	1.55	0.0	74.9	17.8	112.9	0.0	12.5	0.0	210.1	21.0
100670	1.90	0.0	131.6	112.8	62.6	0.0	13.6	0.0	320.6	32.1
100690	2.04	0.0	122.7	93.7	0.0	0.0	97.8	0.0	320.5	31.4
100700	1.27	0.0	76.2	50.2	0.0	0.0	60.7	0.0	195.2	19.5
100710	0.73	0.0	24.0	22.1	0.0	50.1	0.0	0.0	96.2	9.6
100720	1.04	0.0	34.4	31.6	0.0	71.6	0.0	0.0	137.5	13.8
100730	0.75	0.0	50.1	20.0	10.4	0.0	11.0	0.0	100.3	10.0
100740	0.56	0.0	63.9	35.1	43.0	0.0	21.0	0.0	166.7	16.4
100750	1.70	0.0	100.0	54.9	67.2	0.0	34.1	0.0	262.3	25.6
100760	0.41	0.0	31.9	25.0	20.6	0.0	0.0	0.0	137.8	0.5
100770	0.10	0.0	0.0	0.0	21.6	0.0	0.0	0.0	27.0	2.2
100790	0.24	0.0	25.0	23.6	0.0	0.0	0.0	0.0	51.9	4.9
100800	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	160.7	0.0

trno	ingres	tothoh	offsea	priorcrop	priorirrg	pctofftr	offtrno
100020	0.3	0.3	0.00	5.5	5.5	0.0	0
100030	0.0	0.0	0.00	45.5	0.0	0.0	0
100040	0.3	0.3	0.00	5.5	5.5	0.0	0
100050	1.1	1.1	0.02	23.8	23.8	0.0	0
100100	7.6	7.6	0.18	148.4	148.4	0.0	0
100110	3.9	3.9	0.09	75.8	75.8	0.0	0
100120	1.4	1.4	0.03	27.1	27.1	0.0	0
100130	0.0	0.0	0.00	136.7	0.0	0.0	0
100140	1.6	1.6	0.02	36.9	36.9	0.0	0
100150	1.2	1.2	0.02	42.3	26.0	0.0	0
100160	1.2	1.2	0.02	26.5	26.5	0.0	0
100170	1.9	1.9	0.03	41.6	41.6	0.0	0
100180	20.2	20.2	0.49	351.1	351.1	0.0	0
100200	0.3	0.3	0.00	6.2	6.2	0.0	0
100210	1.4	1.4	0.02	30.6	30.6	0.0	0
100230	3.7	3.7	0.07	72.0	72.0	0.0	0
100240	1.8	1.8	0.03	35.1	35.1	0.0	0
100280	8.2	8.2	0.16	163.5	163.5	0.0	0
100290	22.0	22.0	0.38	485.3	485.3	0.0	0
100300	14.8	14.8	0.25	296.6	296.6	0.0	0
100310	33.4	33.4	0.36	369.8	369.8	0.0	0
100320	1.3	1.3	0.02	28.6	28.6	0.0	0
100330	0.4	0.4	0.01	12.1	12.1	0.0	0
100340	18.5	18.5	0.33	364.0	364.0	0.0	0
100350	3.9	3.9	0.07	75.9	75.9	0.0	0
100360	0.6	0.6	0.01	13.6	13.6	0.0	0
100370	0.0	0.0	0.00	6.0	0.0	0.0	0
100380	1.9	1.9	0.03	41.2	41.2	0.0	0
100390	0.3	0.3	0.00	7.0	7.0	0.0	0
100430	7.8	7.8	0.13	155.7	155.7	0.0	0
100440	3.4	3.4	0.06	68.3	68.3	0.0	0
100450	3.6	3.6	0.06	78.1	78.1	0.0	0
100460	0.4	0.4	0.01	7.9	7.9	0.0	0
100470	11.4	11.4	0.18	234.3	234.3	0.0	0
100500	28.4	28.4	0.45	597.7	597.7	0.0	0
100510	0.9	0.9	0.01	20.1	20.1	0.0	0
100520	1.1	1.1	0.02	24.0	24.0	0.0	0
100530	0.0	0.0	0.00	0.0	0.0	0.0	0
100540	3.5	31.0	1.12	37.3	65.7	0.0	0
100560	14.5	14.5	0.24	296.0	296.0	0.0	0
100570	0.0	0.0	0.00	7.5	0.0	0.0	0
100580	0.0	0.0	0.00	4.1	4.1	0.0	0
100620	1.0	1.0	0.03	23.5	18.3	0.0	0
100630	0.3	0.3	0.00	6.0	6.0	0.0	0
100640	40.0	40.0	0.74	891.2	794.3	0.0	0
100660	11.9	11.9	0.22	232.0	232.0	0.0	0
100670	16.8	16.8	0.31	337.4	337.4	0.0	0
100690	16.1	16.1	0.37	336.6	330.3	0.0	0
100700	10.0	10.0	0.23	205.2	205.2	0.0	0
100710	5.2	5.2	0.12	101.4	101.4	0.0	0
100720	7.4	7.4	0.17	144.9	144.5	0.0	0
100732	6.0	11.7	0.13	114.3	114.3	0.0	0
100740	0.0	0.0	0.09	166.7	163.7	50.0	100750
100750	68.3	68.3	0.24	262.3	256.2	0.0	0
100760	4.5	4.5	0.08	142.3	90.0	0.0	0
100770	1.1	1.1	0.02	28.9	22.7	0.0	0
100790	2.6	2.6	0.05	54.5	52.1	0.0	0
100800	0.0	0.0	0.00	160.7	0.0	0.0	0

trno	insea24q	ontrstrgac	ontrstrgdp	pcontrstrgusd
100810	0.20	1.9	10.0	100.0
100820	2.37	36.0	6.0	100.0
100830	0.14	14.2	5.0	100.0
100840	0.62	6.4	10.0	100.0
100850	0.06	0.9	10.0	100.0
100860	0.00	0.0	6.0	100.0
100890	0.08	0.8	10.0	100.0
100940	0.47	4.3	10.0	100.0
100950	0.00	0.0	0.0	0.0
100960	0.11	1.9	10.0	100.0
100970	0.04	0.5	10.0	100.0
101010	3.75	38.3	10.0	100.0
101020	2.09	21.3	10.0	100.0
101030	1.54	15.7	10.0	100.0
101040	0.13	1.2	10.0	100.0
101060	0.00	0.0	6.0	100.0
101110	0.06	0.7	10.0	100.0
101140	0.32	3.3	10.0	100.0
101160	0.87	6.8	10.0	100.0
101170	0.12	1.8	10.0	100.0
101190	0.06	1.0	10.0	100.0
101200	3.18	30.6	9.6	100.0
101210	0.48	7.9	10.0	100.0
101270	1.71	19.8	8.9	100.0
101280	0.33	2.9	10.0	100.0
101300	0.00	0.0	6.0	100.0
101310	0.12	0.8	10.0	100.0
101320	0.33	2.3	10.0	100.0
101330	0.06	1.3	10.0	100.0
101340	0.05	0.4	10.0	100.0
101351	2.41	34.5	6.4	100.0
101352	0.50	27.2	5.5	100.0
101361	1.05	10.2	10.0	100.0
101362	3.07	29.7	10.0	100.0
101370	1.47	15.1	10.0	100.0
101380	0.06	1.9	10.0	100.0
101390	3.29	31.8	10.0	100.0
101400	0.05	1.1	10.0	100.0
101410	0.20	4.9	10.0	100.0
101420	0.04	0.9	10.0	100.0
101430	0.50	5.2	10.0	100.0
101470	0.27	2.1	10.0	100.0
101480	0.31	7.3	10.0	100.0
101500	3.95	49.0	7.7	100.0
101520	0.76	7.5	10.0	100.0
101540	0.00	123.6	1.4	100.0
101550	0.05	0.6	10.0	100.0
101560	2.03	20.5	10.0	100.0
101580	0.00	0.0	6.0	100.0
101590	0.08	1.5	10.0	100.0
101620	0.00	1.0	10.0	100.0
101670	0.59	4.8	10.0	100.0
101691	4.72	39.1	10.0	100.0
101692	0.26	2.1	10.0	100.0
101700	0.38	6.6	10.0	100.0
101710	0.21	1.7	10.0	100.0
101720	0.63	5.1	10.0	100.0
101760	3.24	29.1	10.0	100.0

trno	priebns	offtraf	offtraaf	fwac	ontrstgusc	potstrgav
100020	6	0	0	0.0	2.5	2.5
100030	0	0	0	0.0	0.0	0.0
100040	6	0	0	0.0	2.5	2.5
100050	23	0	0	0.0	10.9	10.9
100100	41	0	0	0.0	76.2	76.2
100110	21	0	0	0.0	38.9	38.9
100120	7	0	0	0.0	13.9	13.9
100130	0	0	0	0.0	0.0	0.0
100140	22	0	0	0.0	16.0	16.0
100150	13	0	0	0.0	12.2	12.2
100160	27	0	0	0.0	12.3	12.3
100170	35	0	0	0.0	18.8	18.8
100180	154	0	0	0.0	201.5	201.5
100200	6	0	0	0.0	2.9	2.9
100210	4	0	0	0.0	14.2	14.2
100230	38	0	0	0.0	37.0	37.0
100240	19	0	0	0.0	18.0	18.0
100280	29	0	0	0.0	82.1	82.1
100290	53	0	0	0.0	220.2	220.2
100300	111	0	0	0.0	147.6	147.6
100310	115	0	0	0.0	196.6	196.6
100320	29	0	0	0.0	13.2	13.2
100330	2	0	0	0.0	4.5	4.5
100340	128	0	0	0.0	185.3	185.3
100350	27	0	0	0.0	38.6	38.6
100360	14	0	0	0.0	5.3	6.3
100370	0	0	0	0.0	0.0	0.0
100380	41	0	0	0.0	19.1	19.1
100390	7	0	0	0.0	3.2	3.2
100430	56	0	0	0.0	77.8	77.8
100440	26	0	0	0.0	33.7	33.7
100450	29	0	0	0.0	38.5	38.5
100460	8	0	0	0.0	3.7	3.7
100470	96	0	0	0.0	114.2	114.2
100500	238	0	0	0.0	264.5	264.5
100510	20	0	0	0.0	9.3	9.3
100520	24	0	0	0.0	11.1	11.1
100530	0	0	0	0.0	0.0	0.0
100540	61	0	0	0.0	34.6	34.6
100560	113	0	0	0.0	145.4	145.4
100570	0	0	0	0.0	0.0	0.0
100580	4	0	0	0.0	0.0	0.0
100620	6	0	0	0.0	12.4	12.4
100630	6	0	0	0.0	2.8	2.8
100640	389	0	0	0.0	399.9	399.9
100660	125	0	0	0.0	118.7	118.7
100670	79	0	0	0.0	168.5	168.5
100690	6	0	0	2.0	161.2	161.2
100700	0	0	0	0.0	99.7	99.7
100710	1	0	0	0.0	51.0	51.0
100720	2	0	0	0.0	74.0	74.0
100730	24	0	0	5.7	60.0	60.0
100740	43	355	170	0.0	0.0	177.6
100750	67	0	0	0.0	177.6	177.6
100760	33	0	0	0.0	45.0	45.0
100770	23	0	0	0.0	12.5	12.5
100790	2	0	0	0.0	26.4	26.4
100800	0	0	0	0.0	0.0	0.0

trno	insea24q	ontrstrgac	ontrstrgdp	pcontrstrgusc
100020	0.02	0.3	10.0	100.0
100030	0.00	0.0	6.0	100.0
100040	0.02	0.3	10.0	100.0
100050	0.07	1.1	10.0	100.0
100100	0.86	7.6	10.0	100.0
100110	0.44	3.9	10.0	100.0
100120	0.16	1.4	10.0	100.0
100130	0.00	0.0	6.0	100.0
100140	0.05	1.6	10.0	100.0
100150	0.07	1.2	10.0	100.0
100160	0.18	1.2	10.0	100.0
100170	0.24	1.9	10.0	100.0
100180	2.27	20.2	10.0	100.0
100200	0.03	0.3	10.0	100.0
100210	0.10	1.4	10.0	100.0
100230	0.40	3.7	10.0	100.0
100240	0.19	1.8	10.0	100.0
100280	0.00	0.2	10.0	100.0
100290	2.11	22.0	10.0	100.0
100300	1.49	14.8	10.0	100.0
100310	2.14	33.4	5.9	100.0
100320	0.00	1.3	10.0	100.0
100330	0.07	0.4	10.0	100.0
100340	1.00	10.5	10.0	100.0
100350	0.29	3.9	10.0	100.0
100360	0.04	0.6	10.0	100.0
100370	0.00	0.0	6.0	100.0
100380	0.20	1.9	10.0	100.0
100390	0.05	0.3	10.0	100.0
100430	0.79	7.0	10.0	100.0
100440	0.34	3.4	10.0	100.0
100450	0.39	3.0	10.0	100.0
100460	0.05	0.4	10.0	100.0
100470	1.16	11.4	10.0	100.0
100500	2.90	20.4	10.0	100.0
100510	0.14	0.9	10.0	100.0
100520	0.07	1.1	10.0	100.0
100530	0.00	0.0	0.0	0.0
100540	0.50	3.5	10.0	100.0
100560	1.47	14.5	10.0	100.0
100570	0.00	0.0	6.0	100.0
100580	0.05	0.0	0.0	0.0
100620	0.12	1.0	10.0	100.0
100630	0.04	0.3	10.0	100.0
100640	3.20	40.0	10.0	100.0
100660	1.20	11.9	10.0	100.0
100670	1.65	16.0	10.0	100.0
100690	1.70	16.1	10.0	100.0
100700	1.06	10.0	10.0	100.0
100710	0.60	5.2	10.0	100.0
100720	0.66	7.4	10.0	100.0
100730	0.62	6.0	10.0	100.0
100740	0.46	0.0	0.0	0.0
100750	1.41	60.3	2.6	100.0
100760	0.34	4.5	10.0	100.0
100770	0.15	1.1	10.0	100.0
100790	0.20	2.6	10.0	100.0
100800	0.00	0.0	6.0	100.0

DITCHILDREN.DAT DATA FILE PRINTOUT AND HEADING EXPLANATION

The following information lists the column heading, the column title, the units of the data, and an explanation of the data for the DITCHILDREN.DAT data file. This file was developed for use with data from the GP.OUT file to run the NETWORK program which accumulates the total acres served and the required flow rate for each segment of the delivery system.

ditch - ditch (no) - The identification number assigned to each section of a canal, stream, or pipeline used as a part of the delivery system network. Four digit numbers (1000) indicate canals or streams. Six and seven digit numbers (1500.061) indicate pipelines.

seg - segment (no) - The identification number assigned to each section of the delivery system network. The segments of each canal, stream, or pipeline are numbered independently.

seg_len - segment length (ft) - The length of this segment of the delivery system network.

c_s_p - canal stream pipeline (no) - An identification code used to identify the type of the delivery system component. The number 1 indicates a canal, 2 indicates a stream, and 3 indicates a pipeline.

trno - tract number (no) - A unique number used to identify a parcel of land within the project area. The tract numbers listed in this file receive import water from the associated segment of the delivery system.

child - child (no) - A lateral canal, stream, or pipeline which receives import water from the associated segment of the delivery system.

ditch	seg	seg_len	c_s_p	trno	child
1000.000	1	6000	1	0	1000.010
1000.000	2	3300	1	308960	1100.000
1000.000	3	3000	1	315900	1200.000
1000.000	4	8000	1	308930	1300.000
1000.000	5	1700	1	0	1400.000
1000.000	6	300	1	0	1500.000
1000.010	1	1300	3	310240	0.000
1100.000	1	13600	2	308770	0.000
1100.000	1	13600	2	308950	0.000
1200.000	1	9800	2	308790	0.000
1200.000	1	9800	2	308800	0.000
1200.000	1	9800	2	309050	0.000
1300.000	1	300	1	0	0.000
1300.000	2	7100	2	308752	1300.010
1300.000	2	7100	2	350390	1300.010
1300.000	3	8000	2	308760	0.000
1300.000	3	8000	2	308780	0.000
1300.000	3	8000	2	308810	0.000
1300.010	1	300	3	308740	0.000
1300.010	1	300	3	308830	0.000
1400.000	1	5500	1	308940	0.000
1400.000	2	6000	2	308751	1400.010
1400.000	3	1	2	0	1400.020
1400.000	4	1400	2	301940	0.000
1400.000	4	1400	2	350400	0.000
1400.010	1	2000	3	309030	0.000
1400.020	1	1300	3	308890	0.000
1500.000	1	5300	1	317680	1510.000
1500.000	1	5300	1	319680	1510.000
1500.000	2	2600	1	317670	1500.010
1500.000	2	2600	1	350360	1500.010
1500.000	3	100	1	0	1500.020
1500.000	4	16700	1	305460	1500.030
1500.000	4	16700	1	305480	1500.030
1500.000	4	16700	1	305490	1500.030
1500.000	4	16700	1	305500	1500.030
1500.000	4	16700	1	310380	1500.030
1500.000	4	16700	1	315660	1500.030
1500.000	4	16700	1	316181	1500.030
1500.000	4	16700	1	317660	1500.030
1500.000	4	16700	1	322920	1500.030
1500.000	4	16700	1	350580	1500.030
1500.000	5	4000	1	322910	1500.040
1500.000	6	2000	1	301780	1520.000
1500.000	7	1700	1	305710	0.000
1500.000	7	1700	1	350590	0.000
1500.000	8	2500	2	305720	1500.050
1500.000	8	2500	2	319300	1500.050
1500.000	9	2800	2	305590	1500.060
1500.000	9	2800	2	305600	1500.060
1500.000	9	2800	2	305730	1500.060
1500.000	10	3500	2	305610	1500.070
1500.000	10	3500	2	305770	1500.070
1500.000	10	3500	2	305800	1500.070
1500.000	10	3500	2	319380	1500.070
1500.000	11	12000	2	0	0.000
1500.010	1	8600	3	310260	0.000
1500.010	1	8600	3	310270	0.000

APPENDIX J

NETWORK.OUT COMPUTER OUTPUT FILE PRINTOUT

NETWORK.OUT COMPUTER OUTPUT FILE AND HEADING EXPLANATION

The following information lists the column heading, the column title, the units of the data, and an explanation of the data for the output from the NETWORK computer program. This program consists of a Unix shell which utilizes the output from the GP.OUT file and the DITCHILDREN file to accumulate the total acres served and the required flow rate for each segment of individual delivery system components.

ditch - ditch (no) - The identification number assigned to a canal, stream, or pipeline used as a part of the delivery system network. Four digit numbers (1000) indicate canals or streams. Six and seven digit numbers (1500.061) indicate pipelines.

seg - segment (no) - The identification number assigned to a part of an individual component of the delivery system network. The segments of each canal, stream, or pipeline are numbered independently.

sirgac - summary irrigated acres (ac) - The accumulated irrigated acres served by a segment of a delivery system component.

mxdevq - maximum delivery q (cfs) - The accumulated maximum flow rate required by a segment of a delivery system component to supply the imported water need.

ditch	seg	sirgac	mxdevq
1000.000	1	272443.6	1578.57
1000.000	2	272422.5	1578.45
1000.000	3	271849.8	1576.22
1000.000	4	271833.8	1576.13
1000.000	5	270448.6	1571.08
1000.000	6	269637.3	1567.33
1000.010	1	21.1	0.12
1100.000	1	166.3	1.00
1200.000	1	16.0	0.09
1300.000	1	264.3	1.56
1300.000	2	264.3	1.56
1300.000	3	137.9	0.82
1300.010	1	31.0	0.18
1400.000	1	811.3	3.75
1400.000	2	339.0	2.13
1400.000	3	85.0	0.64
1400.000	4	58.2	0.60
1400.010	1	142.4	0.84
1400.020	1	26.8	0.04
1500.000	1	3353.6	17.69
1500.000	2	2848.2	15.79
1500.000	3	2712.5	15.34
1500.000	4	2699.1	15.05
1500.000	5	2056.4	7.38
1500.000	6	1341.3	4.92
1500.000	7	619.9	2.30
1500.000	8	582.8	2.17
1500.000	9	409.7	1.58
1500.000	10	100.3	0.41
1500.000	11	0.0	0.00
1500.010	1	7.8	0.05
1500.020	1	13.4	0.29
1500.030	1	98.8	1.14
1500.040	1	152.9	0.93
1500.050	1	117.4	0.34
1500.060	1	292.1	1.08
1500.060	2	216.7	0.76
1500.061	1	75.4	0.32
1500.070	1	21.6	0.07
1510.000	1	143.4	0.49
1510.000	2	52.8	0.15
1520.000	1	690.8	2.43
1520.000	2	400.7	1.47
1520.000	3	232.5	0.78
1520.000	4	2.0	0.01
1520.010	1	28.9	0.20
1520.020	1	110.6	0.48
1520.030	1	34.4	0.12
1999.000	1	133.1	1.25
1999.000	2	25.9	0.18
1999.000	3	16.4	0.13
1999.000	4	11.4	0.07
2000.000	1	266150.6	1548.39
2000.000	2	265267.7	1546.07
2000.000	3	262972.5	1536.78
2000.000	4	232499.8	1394.89
2000.000	5	232177.7	1392.57
2000.000	6	231391.1	1387.48

708,462 GPM 2.6 GPM/AC

GLOSSARY

ACRE-FOOT - The volume of water required to cover one acre to a depth of one foot.

AGRICULTURAL STABILIZATION AND CONSERVATION SERVICE (ASCS) -

A U.S. Department of Agriculture (USDA) agency responsible for administering farm price and income support programs as well as some conservation and forestry cost-sharing programs.

BASE ACRES - The acres on a farm that are eligible for federal program payments. Base acres for each year are calculated as the average number of acres enrolled in a specific commodity program during the previous 5 years.

CHANNEL - A natural stream or manmade canal utilized for the delivery of water.

TRACT - The smallest designation on which ASCS records are maintained and is a contiguous piece of property with single or group ownership.

TRACT NUMBER - An identifier for the tract. No two tracts in a county have the same identifier.

TOTAL FARMLAND ACRES - This is the total acres recorded for a farm. This can include crops, farm headquarters, woods, etc. This area can be composed of several tracts under a unique ownership.

CROPLAND ACRES - This is the total crop acres available on the tract.

CUPCP/GRASS/OTHER C ACRES - Cropland on tracts that have grass or other than irrigated crops.

CONSERVATION RESERVE PROGRAM (CRP) - A program authorized under the Food Security Act of 1985 that allows up to 45 million acres of highly erodible land to be placed into a 10-year reserve. Land in the reserve must be under grass or tree cover to protect it from erosion. It is not allowed to be used for hay production or livestock grazing.

CELL NUMBER - A tracking procedure that includes a cell number that identifies all 9 square mile cells within the project boundary. These cells have the ground water availability identified according to the Corps of Engineers/USGS Study made.

Corps of Engineers PHOTO - The identifying number for each of the 1:24,000 aerial photography photos for the project area.

CROP ROTATION - The successive planting of different crops in the same field over a period of years. Farmers using rotations typically plant a part of their land to each crop in the rotation. A common 2-year rotation in the project area is rice-soybeans.

FARM NUMBER - An identifier for the owner/owners for the farm and the farm number has a list of the associated tracts on the farm. A tract is the smallest unit that is used in this evaluation.

BASE ACREAGE - The acreage per crop allocated by ASCS for yearly farm production by farm. These are Rice, Wheat, Oats, Corn and Grain Sorghum. Cropland acres minus base acreage plus wheat acres.

FISH POND ACRES - The acres of fish pond/ponds on a specific tract planimetered from the Corps of Engineers aerial photography.

FISH POND DEPTH - The average estimated depth of the fish pond/ponds on a specific tract.

IRRIGATION STORAGE ACRES - The acres of the irrigation water storage on a specific tract planimetered from the Corps of Engineers aerial photography.

IRRIGATION STORAGE DEPTH - The average estimated depth of the irrigation water storage on a specific tract.

F/W LAKE ACRES - Fish and wildlife acres of lakes or reservoirs in a specific tract.

F/W LAKE DEPTH - Fish and wildlife lakes or reservoirs average estimated depth.

RECHARGE - The replenishment of an aquifer with water from the land's surface.

ROW CROPS - Crops that require planting each year and are grown in rows, such as corn, soybeans, and sorghum.

WATER-HOLDING CAPACITY - The ability of a soil and crop system to hold water in the root zone.